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Contents

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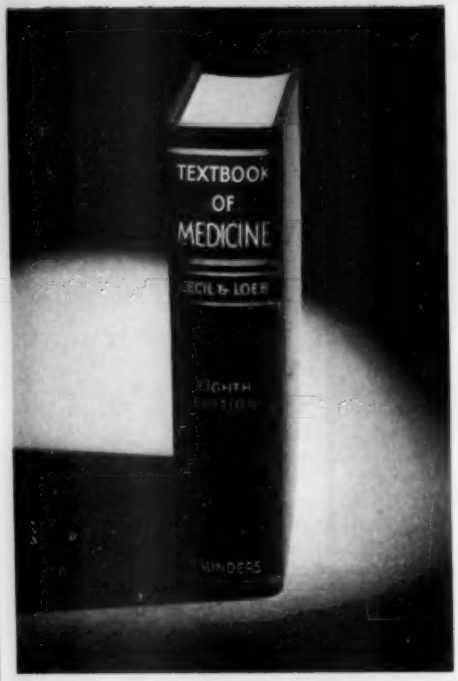

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Science and Civil Defense

THERE is scarcely a science from astronomy to zoology that does not have a bearing, however remote, on civil defense. Every scientist in the United States has an individual measure of responsibility in the civil defense program, if only because laymen, rightly or not, look to scientists for answers to many crucial problems. The Federal Civil Defense Administration has learned from scientists working in the sociological and public reaction fields that, increasingly, the American people look to the scientist as an authoritative source of information.

Public esteem imposes a special burden of responsibility on the scientist, for, when he discusses present or possible weapons and defenses against them, he must weigh his words with more in mind than the reactions of his fellow-scientists. He must consider the effect of whatever he has to say on an already badly confused public.

In civil defense the responsibility of the scientist extends far beyond the evaluation of the possible public effect of his words. In many situations the scientist must assume leadership, and because of his background he may be the best possible teacher. This is particularly true in special-weapons defense. The veterinarian, the botanist, the plant pathologist, the epidemiologist, the bacteriologist, and the pathologist are admirably equipped to instruct in the field of biological warfare defense. The biochemist and the physical chemist can do much to aid in chemical warfare defense. Scientists in the fields of nucleonics and radiology should participate actively in radiological defense training programs. These are merely a few examples.

The active participation of scientists in civil defense state and local operational programs is vital. The role of the physician, the sociologist, the psychologist, the psychiatrist, the engineer, and the many specialists in fields directly applicable to the civil defense problem is apparent. Scientists should seek out state and local civil defense directors and offer not only technical advice but active service.

Certain it is that scientists, as individuals assisting local civil defense organizations, as individuals or groups advising state and local civil defense directors, and as responsible members of professional societies, can make major contributions to civil defense planning and operation. Without the active cooperation of scientists, and without the knowledge that they alone can provide in many areas, civil defense cannot be effective, and the Federal Civil Defense Administration is keenly aware of this fact.

Civil defense has been working for some time with many of the organizations affiliated with the AAAS. For example, in our publication *Health Services and Special Weapons Defense,* we recognize the contributions of the American Association of Blood Banks, the American Dental Association, the American Hospital Association, the American Medical Association, and the College of American Pathologists. Future publications will acknowledge the cooperation and contributions of other groups affiliated with the AAAS. But our cooperation with scientists must and will extend far beyond these contacts. We are spending considerable time at civil defense headquarters in outlining research programs and defining areas in which we must have additional scientific and technical knowledge to operate effectively.

Recently it was suggested that there is no science we do not need. The wry qualification was added that, if saturation attacks with modern weapons ever are made on the United States, and civil defense is not effective, then some of the sciences, such as archaeology, not directly involved in civil defense, may inherit what is left of the nation we have failed to protect.

MILLARD CALDWELL
Federal Civil Defense Administration
Washington, D. C.

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Atomic Spectra for the Astrophysicist[1]

Charlotte E. Moore

National Bureau of Standards, Washington, D. C.

IN THE application of quantum theory to astronomy atomic spectra have played a major role. The discoveries of "regularities" among the wave numbers of spectral lines, of multiplets, of series, and of the Bohr theory are inseparable parts of the intricate picture fitted together by the quantum theory to describe the properties of atoms as we know them today.

Without this theory the astrophysicist was restricted to a qualitative interpretation of astronomical spectra, such as the chemical identifications of spectral lines and the measurement of radial velocities. He is directly dependent upon the quantum theory for the quantitative chemical analysis of celestial spectra—for his knowledge of the physical properties of the stars, such as temperature and pressure; for his interpretation of the many kinds of lines excited in celestial sources. It is not the purpose of this paper to stress the cosmological importance of this development, but to offer some comments regarding the present status of atomic spectra, with special emphasis on astrophysical problems.

In 1946 a program was instituted at the National Bureau of Standards on the compilation of "Atomic Energy Levels as Derived from the Analyses of Optical Spectra." This program entails the critical editing of all analyses of optical spectra and the tabulation of the electron configurations, term designations, energy levels, term intervals, and observed g-values of the individual spectra—all presented in a uniform style and notation. Arrays of predicted terms of the various configurations are also included for each type of spectrum, with similarly arranged arrays of observed terms for the more complex spectra. All levels are listed from the ground state as zero, with the limit and ionization potential appearing in the heading for a given spectrum. A similar project was carried out by Bacher and Goudsmit in 1932. Their classical book on *Atomic Energy States* included atomic energy levels for 231 spectra of 69 elements. At present something is known about the structure of 501 spectra of 84 elements.

Volume I, published in 1949, includes 206 spectra of the elements $_1$H–$_{23}$V (*1*). Volume II will include 152 spectra of the elements $_{24}$Cr–$_{41}$Nb. Of the 152, 131 are in galley proof, 16 more are in press, and 2 additional spectra have been completed, leaving 3 unfinished.

Such a compendium enables one to survey the upper half of the periodic table with regard to the behavior of the outer electrons of the various atoms. The correctness of the interpretation of individual spectra can readily be studied by comparing similar and related spectra. Along the isoelectronic sequences the spectra are similar, although the related lines acquire greater frequencies as the sequence progresses to the spectra of higher ionization. The electronic structure is the same for all members of the sequence, even though the terms are not necessarily in the same order throughout. Spectra in the same stage of ionization, of elements that appear in the same vertical columns of the periodic table, are likewise similar in structure.

The first over-all survey of Volumes I and II, so far as the writer is aware, has come about quite incidentally through the request of Forsythe for a revision of the tables on "Binding Energies," to be included in the forthcoming edition of the *Smithsonian Physical Tables*. These particular tables give the maximum binding energy of the running electrons in first and second spectra. This quantity is determined by converting the absolute value of the lowest energy level assigned to a given running electron into electron volts. Where two limit terms are involved, as, in this instance, for the spectra K I–Zn I, Rb I–Nb I, care must be exercised to refer the level in question to the proper limit. If the two limit terms are handled separately in grouping the binding energies of successive spectra, the runs are regular.

H. N. Russell and the writer have recently prepared two of these tables, one for first, and one for second spectra of the elements $_1$H–$_{41}$Nb, utilizing the data in Volumes I and II of *Atomic Energy Levels*. This survey has revealed some interesting facts. In Si I, for example, a serious discrepancy existed in the binding energy of the 3d-electron as given in Volume I of *Atomic Energy Levels*. There are two low ^{3}D° terms in Si I, one from $3s\ 3p^3$ and the other from $3s^2\ 3p(^3\text{P}^\circ)3d$. In this volume the lower term, ascribed to the latter configuration, was used to calculate the binding energy. The results run as follows:

Spectrum	$3d$
Na I	1.52
Mg I	1.89
Al I	1.96
Si I	2.54
P I	1.83
S I	1.94

By interchanging the published configurations of these two ^{3}D° terms, the binding energy is determined from $3d\ ^1\text{D}^\circ_2$, which lies between the two triplet terms. This gives the improved value 2.28, instead of 2.54, for Si I; and the run compares favorably with

[1] Based on a paper presented at the Joint Symposium of Sections D and B of the AAAS on "Fifty Years of Quantum Theory in Astronomy," Cleveland, Ohio, December 27, 1950.

that of the elements Li I–O I, which are directly above this group in the periodic table.

The *d*-electrons in Br I also deserve mention. Here the binding energies run as follows:

Spectrum	4*d*	5*d*
Ga I	1.69	0.94
Ge I	1.87	1.02
As I	2.03	—
Se I	1.89	1.03
Br I	0.71	0.47
Kr I	2.00	1.13

The values 0.71 and 0.47 should probably be ascribed to the 6*d* and 7*d* electrons, according to Russell. The terms from 4*d* and 5*d* are evidently not known as yet.

From these general calculations Russell has concluded that it would be advisable to use the *average* value of the energy levels of related terms—triads, pentads, etc.—rather than the lowest level of the group, as has been done in the revised tables. Average values should have been adopted, but the laborious calculations have not been repeated.

The publication of Volume I appears to have stimulated requests for ionization potentials. The literature on this subject is, admittedly, confusing. An attempt is being made to improve the situation (1) by giving the limit for each spectrum referred to the ground state of the ion, (2) by using the same factor throughout to convert the limits to electron volts, and (3) by stating what series have been observed and what series formula has been used to derive the ionization potential.

It has long been known that limits based on series of only two members are too high. Russell has recently restated that a reevaluation of limits is important in such cases: "If but two members are available, serious errors occur if the Ritz correction is ignored." In the course of the work on binding energies, he has revised the limits of the second spectra of the elements of the iron group, utilizing additional series from recent analyses. Good series have been observed in the spectra of Ca II, Mn II, Cu II, and Zn II. He has corrected the Rydberg denominators by an empirical formula that fits these four spectra, and has thus derived revised limits and ionization potentials for the intermediate spectra: Sc II, Ti II, V II, Cr II, Fe II, Co II, and Ni II (*2*). He states that

> This method is familiar, but published estimates have not been made on a uniform system. Such estimates for spark spectra from Ca II to Zn II give ionization potentials differing from a smooth formula by ± 0.02 volt, while the differences in the three cases where the Ritz correction was not applied, average ± 0.39 volt.

Finkelnburg (*3*) has made similar calculations for spectra of many degrees of ionization, by utilizing the regularities in the change of the screening constant.

Other adjustments have resulted from the intercomparison of binding energies. A few selected ones have been mentioned to indicate that this method of approach may prove to be a useful guide in handling the complex spectra to be included in Volumes III, IV, etc., of *Atomic Energy Levels*.

Even though the conditions of excitation in celestial sources have so far not been quite duplicated on earth (fortunately), yet in astrophysics the progress of the astronomer and the spectroscopist go hand in hand. This statement is confirmed by an event that occurred in Cambridge, England, last September, when a Joint Commission for Spectroscopy was formed. The Commission consists of twelve members, six representing the International Union of Pure and Applied Physics, and six the International Astronomical Union. The purpose is to coordinate the work of the spectroscopists and the astronomers with regard to both atomic and molecular spectra. On this occasion three papers were presented at a symposium on spectra: W. F. Meggers described the present state of atomic spectra; R. W. B. Pearse discussed laboratory molecular spectra; and P. Swings reviewed the needs of astronomers in interpreting astronomical spectra of all types. The results were enlightening. Summarized all too briefly, the more urgent needs are as follows:

a) Infrared observations of second spectra of elements in the iron group, especially Fe II. (It would be well to include here also the first spectra of this group of elements.)

b) Laboratory investigations of the third spectra of these elements (the metals in general) over the maximum spectral range. (Only Fe III and Cu III have a Grade A analysis.)

c) More work on spectra of higher ionization. (Fe IV and Fe V, in particular, are badly needed. Forbidden lines are especially important in this group.)

d) More analysis on the spectra of the light elements and more terms of other spectra that are cosmically abundant, even though the present analyses appear to be fairly complete: C I to C IV, N I to N V; O II to O VI, Si III, Si IV.

e) Second and third spectra of rare earths.

Swings' paper left the impression that the study of celestial spectra is only well begun, and that laboratory observations are still inadequate for the solution of many astrophysical puzzles among the spectra of stars all along the sequences—the Wolf-Rayet stars, the B-stars, the giants, the dwarfs, and the cool red stars, peculiar stars—and in the spectra of nebulae, novae, comets, planets, interstellar matter, the night sky, the sun, and the corona. Many hundred unexplained lines over the whole observable range still challenge the spectroscopist.

In 1945 (*4*) a Multiplet Table was prepared expressly to aid in the study of astronomical spectra. The short wave limit of this table was 3,000 A, a limit set by the ozone in the earth's atmosphere, which cuts off observations of celestial spectra near this point. Almost overnight this table became out of date. The shorter ultraviolet solar spectrum was recorded, during the flights of two V-2 rockets, at an altitude above the ozone layer. The leading lines, long anticipated—the Mg II pair at 2,795 A and 2,802 A (analogues of H and K of Ca II), one strong line of

Mg I at 2,852 A, and one of Si I at 2,881 A—stand out on these films conspicuously enough to gratify the solar physicist. The other lines are seriously blended, and the identifications depend on a careful study of ultraviolet multiplets of well-known spectra. The rocket spectra have thus provided the impetus for the preparation of an Ultraviolet Multiplet Table (*5*), which is now being compiled along with the compendia of *Atomic Energy Levels*. This multiplet table includes, also, lines in the short-wave region that are responsible for the forbidden transitions observed in the nebulae, etc. The writer is attempting to include all important ultraviolet lines that may prove to be useful in disentangling complicated astrophysical spectra.

These programs, fortunately, involve much more than writing down in a uniform style the data known on atomic spectra. Every effort has been made to stimulate work on spectrum analysis, with particular emphasis on unknown or incompletely known spectra of astrophysical importance. The result has been rewarding in more than one respect. There has been the most cordial cooperation, national and international. Manuscripts have already been received, in advance of publication, that anticipate some of the needs pointed out by Swings.

One of the fountain sources of material is, naturally, the Spectroscopy Section of the National Bureau of Standards. W. F. Meggers is chiefly responsible for the recent completion of a study of As I. He is progressing rapidly with the analyses of Tc I and Tc II (element 43), which was obtained from Oak Ridge in sufficient quantity for spectroscopic study. He, with Scribner and Bozman, has also observed the Pm spectra (element 61), but the lines of Pm I and Pm II have not been separated as yet. In the same laboratory, C. C. Kiess has furnished extended analyses of the very complex spectra Cr I and Cr II. He now has about 2,800 classified lines of Cr I in the range between 1,988 A and 11,610 A, and 1,400 of Cr II between 1,200 A and 7,300 A. All extra copies of proof giving the energy levels of these two spectra are now in the hands of astronomers. Mn I and Mn III are being completed by M. A. Catalán, of the University of Madrid, who discovered multiplets in 1921 while working in Fowler's laboratory on the spectra of Mn. Mn II has been greatly extended by C. W. Curtis, and Co II by N. E. Hager, Jr., both of Lehigh University. A. G. Shenstone, at Princeton, has given his wholehearted support to this program. He has observed many spectra in the short-wave region ($< 2{,}000$ A) and thereby made it possible for others to extend their work—for example, Cr I to Cr IV, Mn I to Mn IV, Co II, As I, etc. In addition, he is working on the analyses of Co III and Ni III and has furnished his recent results on Cu III, and new data on Ni II. F. L. Moore, Jr., who started his spectroscopic work at Princeton, is investigating Cr III, Cr IV, and Mn IV. Extended series in Ge II have been furnished by C. W. Gartlein. W. E. Albertson has supplied additional terms of Ce II. Finally, B. Edlén, of Lund, has contributed provisional unpublished work on the analyses of high ionization spectra in two sequences:

Ni I sequence: Se VII, Br VIII, Rb X, Sr XI, Y XII.
Co I sequence: Br. IX, Rb XI, Sr XII, Y XIII, Zr XIV.

(The missing spectrum in the former group, Kr IX, is being studied by F. W. Paul at Fort Belvoir.) The Joint Commission for Spectroscopy may well feel encouraged by the cooperation and accomplishment demonstrated by this impressive array of unpublished material.

No discussion of quantum theory would be complete without reference to one particular stellar spectrum—that of our nearest star, the sun. Rowland published his classical work on *Solar Spectrum Wave Lengths* in 1895–97, before the quantum theory was known. His observations extended from 2,975 A to 7,330 A. Excluding the ultraviolet rocket spectra mentioned above, there are now some 26,000 lines recorded in the solar spectrum in the photographic range 2,950 A–13,495 A. In certain regions atmospheric lines mask the real solar spectrum, but they constitute a relatively small percentage of the total number. As laboratory spectra become better known, it is possible to revise and extend the identifications of solar lines.

In 1928 (*6*) Charles E. St. John and others at Mount Wilson revised Rowland's original table of solar spectrum wavelengths and reported 57 elements present in the sun, as against 39 found in Rowland's *Table*. At that time some 1,700 lines were included beyond the red limit of the Rowland *Table*—i.e., 7,330 A–10,218 A. In 1918 Meggers had observed the infrared spectrum as far as 9,000 A. It was well known that the sensitivity of Rowland's plates decreased rapidly from 6,600 A to longer waves. When red-sensitive plates were improved, the solar spectrum was, therefore, observed from 6,600 A to 13,495 A at Mount Wilson, and more than 7,400 lines were recorded in this region. The new data were published by H. D. Babcock and the writer in 1947 (*7*). At that time 66 elements were listed as identified in the sun.

Meanwhile, Minnaert, Mulders, and Houtgast, at the Utrecht Observatory, prepared a *Photometric Atlas of the Solar Spectrum* (*8*) that extends from 3,332 A to 8,771 A, utilizing plates taken at Mount Wilson. This is no ordinary atlas. It consists of 173 pages $12'' \times 17''$, each containing two uniformly calibrated microphotometer tracings on millimeter paper, the scale being 1 A/20 mm. One can literally read the solar spectrum from these tracings. The staff at Utrecht is now engaged in measuring the equivalent widths of all the solar lines in this atlas, to replace Rowland's visual estimates of intensity used in the 1928 edition, and perpetuated in the 1947 publication.

The International Astronomical Union, at the General Assembly in Zurich in 1948, placed on its agenda the second revision of Rowland's *Table of Solar Spectrum Wave Lengths*. Active work on this project is now in progress. In the second revision the wavelengths will be corrected to the IAU standards of 1928 (1922 standards having been previously used for Rowland's lines). The wavelength range will be 2,950 A–

TABLE 1

ELEMENTS IN THE SUN

Present—no special comment	H, He, Be, C, N, O, Na, Mg, Al, Si, P, S, K Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge Sr, Y, Zr, Cb, Mo, Ru, Rh, Pd, Ag, Sn, Sb, Ba, La Ce, Pr, Nd, Sm, Eu, Gd, Dy, Tm, Yb, Lu, Hf, W, Os Ir, Pt, Pb	55	
Evidence from sunspot spectrum	Li, Rb, In	3	
Present in compounds only (BH, MgF, SrF)	B, F	2	
Only one line present	A,* Cd, Au, Th	4	
Present with a question	Tb, Er, Ta	3	
Total number present			67
Indeterminate	As, Tc	2	
Insufficient laboratory data	Pm, Ho	2	
			4
Total number absent†			15
Ultimate lines accessible	0.0 Cs, 0.0 Re, 0.0 Tl, 0.0 Bi, 0.0 Ra, 0.0 U	6	
Ultimate lines inaccessible	4.9 Hg, 5.5 Te, 6.0 Se, 6.9 I, 7.8 Br, 8.3 Xe, 8.9 Cl, 9.9 Kr, 11.5 A†, 16.6 Ne	9	
Not to be expected	Po, At, Rn, Fa, Ra§, Ac, Pa, Np, Pu, Am, Cm, Bk, Cf	12	

* Forbidden line identified in spectrum of corona as [A x].
† The low excitation potential of the accessible lines is entered above the chemical symbol for the absent elements.
§ Entered also in group with ultimate lines accessible.

13,495 A, with the recent Mount Wilson observations (*9*) replacing Rowland's between 2,950 A and 3,060 A. Revised identifications and the Utrecht equivalent widths will be given. For atomic lines the revisions in identifications will be based on the data being assembled for the Atomic Energy Level program. The low excitation potential will be entered for atomic lines, and in the same column of the table, band spectrum data for molecular lines.

At present about 30 per cent of the lines observed in the solar spectrum still remain unidentified. As Russell has pointed out, many of these are doubtless of molecular origin, solar or terrestrial. As work on analysis of atomic spectra progresses in the laboratory, however, so does the solar spectrum keep revealing secrets. For example, almost every line of Fe I that has been observed in the laboratory is present in the solar spectrum. From the energy levels, the positions of many additional lines can be predicted. Many of these predicted lines are unquestionably present in the sun, thus indicating that the sun is a favorable source for faint lines of Fe I. Systematic laboratory observation of this complex spectrum over the entire range, with a source suitable for exciting the weakest lines, would undoubtedly provide many additional solar identifications. In fact, a number of predicted Fe I lines found in the sun have already been confirmed in the laboratory (*10*).

With respect to the solar spectrum in the far infrared region, where observations have been made by means of improved detectors, the work of Adel, Migeotte, McMath, Goldberg, Mohler, Chapman, Shaw, and others emphasizes the need of laboratory atomic spectra of the more abundant elements. In spite of the numerous atmospheric bands, a number of lines of the more abundant elements, predicted from the Atomic Energy Levels, have been identified, the most notable being, perhaps, Fe I and Si I. The laboratory data are seriously inadequate for future work in this region. R. Fisher, at Northwestern University, is now extending the analysis of Fe I from observations in the far infrared. C. J. Humphreys is doing similar work on Si I, Ca I, and Sr I at the National Bureau of Standards. It is hoped that suitable detectors will be developed in the near future for exploring other infrared atomic spectra as well.

The present status of the knowledge of elements in the sun is summarized briefly in Table 1. The elements marked "present" have been discussed in the literature and require no comment. Argon, however, deserves special mention. It is added as present on the strength of Edlén's identification of one coronal line at 5,536 A (*11*) as due to a forbidden transition of argon atoms that have lost 9 electrons, namely, [A x]. This brings the total number of elements identified in the sun to 67.

The ultimate lines of B I, Tc II, and Hg I, and the low-level lines of As I lie between 2,288 A and 2,647 A. The existing rocket spectra that cover this region are of such low dispersion that all lines are badly blended and therefore do not provide a test as to whether these particular lines are present. Since boron is present in compounds, its ultimate atomic lines should be present. It would also be interesting to hunt for the Hg I line.

The two elements As and Tc are labeled "indeterminate" for widely different reasons. The accessible lines of As I are so blended or masked by other ele-

nents known to be present in the sun that it appears impossible to decide definitely about its presence, although it may reasonably be expected. The three strongest accessible lines of Te II are all accounted for in the sun—one as a blend with Co I, one as masked by Fe I, and one as possibly present and unblended. This may furnish evidence of the presence of element 43, but the most stable known isotope, ^{99}Te, has a half-life of less than a million years, which is a relatively short time compared with the age of the sun. This casts doubt on the evidence. One wonders whether Tc is as rare in nature as is at present supposed.

There are many more astrophysical problems than the three special topics that have been emphasized here—atomic energy levels, the ultraviolet multiplet table, and the second revision of *Rowland's Table of Solar Spectrum Wave Lengths*. Our knowledge of forbidden lines is probably far from complete. The quantitative determination of cosmical abundances of the chemical elements will continue to attract its full share of attention as one of the most important problems. The measurement of line intensities in laboratory and stellar spectra is also of prime importance to both astronomers and physicists. Our study of atomic spectra may be well begun, but who can guess how many secrets will be revealed by the atom in the next fifty years?

References

1. Moore, C. E. *Circ. Natl. Bur. Standards.* Vol. I, 467 (1949); Vol. II (in press).
2. Russell, H. N. *J. Optical Soc. Am.*, **40**, (9), 618 (1950).
3. Finkelnburg, W., and Stern, F. *Phys. Rev.*, **77**, (2), 303 (L) (1950); Finkelnburg, W. *Ibid.*, 304 (L) (1950); *Bull. Am. Phys. Soc.*, **25**, (3), 22 (A) (1950).
4. Moore, C. E. *Contribs. Princeton Univ. Observ.* **20** (1945).
5. ———. Sec. 1, *Circ. Natl. Bur. Standards.*, 488 (1950); Sec. 2 (in press).
6. St. John, C. E., *et al. Carnegie Inst. Wash. Pub. 396; Papers of the Mt. Wilson Observ.* III (1928).
7. Babcock, H. D., and Moore, C. E. *Carnegie Inst. Wash. Pub. 579* (1947).
8. Minnaert, M., Mulders, G. F. W., and Houtgast, J. *Photometric Atlas of the Solar Spectrum, 3332 A–8771 A.* Utrecht: Sterrewacht Sonnenborgh (1940).
9. Babcock, H. D., Moore, C. E., and Coffeen, M. F. *Astroph. J.*, **107**, 287; *Contribs. Mt. Wilson Observ.* 745 (1948).
10. Kiess, C. C., and Moore, C. E. *Astron. J.*, **55**, 173 (1950).
11. Edlen, B. *Monthly Notices Roy. Astron. Soc.*, **105**, (6), 323 (1945).

Technical Papers

In Vitro and *In Vivo* Production of a Ceroidlike Substance from Erythrocytes and Certain Lipids[1]

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Ceroid, an orange-brown pigmented deposit which is insoluble in alcohol, xylol, and ether, sudanophilic, and acid-fast (*1*), is found in fibrous trabeculae of cirrhotic livers of rats which have been fed a diet low in choline and its precursors. Pathological accumulation of fat in hepatic parenchyma, which always precedes and accompanies this type of fibrosis, is greatest in centrolobular regions (*2*), which are also the sites of initial fibrosis (*3*) and ceroid deposition. The same lobular area is the locus for formation of pathological fatty cysts. These atrophy and become surrounded by bands of connective tissue, so that fibrotic replacement of atrophied cysts appears to be the mechanism by which the cirrhotic lesions develop (*4*). Degeneration of a cyst may frequently be initiated by a small hemorrhage into its lumen, in which erythrocytes and lipid become intimately mixed (*5*). These red cells neither become thrombosed nor disintegrate to form hemosiderin, but it is noteworthy that it is in these regions ceroid is deposited. Furthermore, the only animals in which hemosiderin deposits in the livers could be demonstrated belonged to a special group of cirrhotic rats[2] which were largely free of ceroid. These observations suggested that, under favorable conditions, some types of lipid might react with some component of red blood cells to produce ceroid in a manner that at the same time prevented the formation of hemosiderin from the altered erythrocytes. It had been noted that some granules of ceroid resembled erythrocytes in shape and size. The possibility of making ceroid from red cells and fat was therefore attempted *in vitro* and *in vivo*.

Cod liver oil was mixed in a test tube with one tenth the volume of heparinized, washed red cells of an adult rat of the Wistar strain, and incubated for 5 days at 37° C with manual agitation at frequent intervals. The centrifuged sediment was washed repeatedly with ethyl alcohol, xylol, and ether to remove all traces of cod liver oil, affixed to gelatinized microslides, stained by a variety of methods, and examined microscopically. Many erythrocytes, although deformed, exhibited the normal staining reaction to Light Green (Color Index No. 670) and failed to show any trace of sudanophilia. Groups of others, which were often crenated, clumped, and granular, no longer stained with Light Green and were strongly sudanophilic. Aggregates of red cells altered in this

[1] This work was supported by grants from the National Cancer Institute of Canada and from the National Research Council of Canada.

[2] These animals were fed a basal choline-deficient diet supplemented with 10 mg of α-tocopherol acetate per 10 g of food mixture. The diet contained 57.5% sucrose, 12% fat, 22% protein (arachin 12%, gelatin 6%, casein 3%, fibrin 1%), with a supplement of 0.5% cystine, 1% vitamin powder (*6*), a cod liver oil concentrate, and 5% salt mixture.

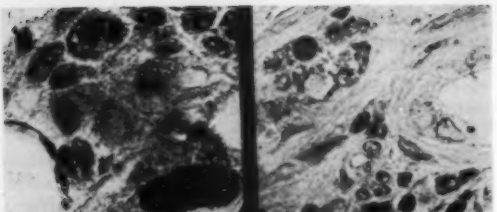

FIG. 1. Masses of ceroidlike pigment in traumatized mesenteric tissue of a rat. The sudanophilic material appears black in the photograph.

FIG. 2. Ceroid in the fibrous tissue in a section of cirrhotic liver of a choline-deficient rat. The sudanophilic pigment (black) lies in clumps which correspond to the distribution of cystic hemorrhages.

Both photomicrographs are of paraffin sections stained with Oil Red O, hematoxylin, and Light Green. (× 650.)

manner resembled ceroid in other ways, for they were acid-fast, Prussian blue–negative, fluorescent,[3] and reacted positively to Mallory's hemofuchsin test; unstained they were orange-brown.

In a second experiment, 0.10 ml of heparin[4] was injected locally into a loose tag of fatty mesenteric tissue of each of 5 adult male rats of the Wistar strain subjected to laparotomy under ether anesthesia. A loosely tied ligature around the root of the mesenteric tag impeded venous return and systemic absorption of the anticoagulant. Fatty hematomata were produced by crushing the tissue between hemostats. The incisions were closed, penicillin was administered subcutaneously to prevent infection, and the animals were maintained on a stock diet for 10 days. Paraffin sections of the traumatized mesentery obtained at autopsy were examined by the methods used to identify ceroid. The morphology (Figs. 1, 2) and histochemistry of pigment found in the scar tissue differed in no essential from that of ceroid.

These results indicate that under certain conditions a mixture of lipids and some component of free red cells can produce ceroid or a closely related substance. Perhaps cells other than erythrocytes are capable of a similar reaction with certain lipids; this is under investigation. Preliminary experiments[5] with fat extracted from livers of choline-deficient rats have indicated that this lipid may react *in vitro* with erythrocytes to produce the same results obtained with cod liver oil. These observations may indicate means of further investigations concerning the nature not only of ceroid, but also of other lipochrome pigments.

[3] The fluorescence of ceroid in sections was first described by Popper *et al.* (7). The fluorescence of lightly colored particles of the substance produced *in vitro* above was light-brown; darker particles exhibited little fluorescence. The writer is indebted to Hans Popper, of the Hektoen Institute for Medical Research, of the Cook County Hospital, Chicago, who made the fluorescent examination for this report.

[4] Supplied in a solution of 1,000 u/ml in physiological saline by the Connaught Medical Research Laboratories, University of Toronto.

[5] These experiments and others of a similar nature have been conducted by W. G. B. Casselman, Banting and Best Department of Medical Research, University of Toronto, and will be published elsewhere.

References

1. LILLIE, R. D., DAFT, F. S., and SEBRELL, W. H., JR. *U. S. Pub. Health Repts.*, **56**, 1255 (1941).
2. HARTROFT, W. S. *Seminar on Metabolic Aspects of Liver Function.* Metabolic and Endocrinology Study Section of the National Institute of Health, USPHS, 15 (1948).
3. LILLIE, R. D., *et al. U. S. Pub. Health Repts.*, **57**, 502 (1942).
4. HARTROFT, W. S. *Anat. Record*, **106**, 61 (1950).
5. HARTROFT, W. S. and RIDOUT, J. H. (To be published.)
6. RIDOUT, J. H., *et al. Biochem. J.*, **40**, 494 (1946).
7. POPPER, H. GYÖRGY, P., and GOLDBLATT, H. *Arch. Path.*, **37**, 161 (1944).

An *in Vitro* Method of Screening Amebicidal Agents Using the Phillips Culture

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The testing of potential amebicidal compounds by *in vitro* methods is unfortunately beset with several difficulties. The most important is the problem of determining whether an "active" compound is truly amebicidal or whether its action is only indirect and, presumably, due to the inhibition or destruction of necessary bacterial associates. This difficulty is somewhat lessened by the use of *Endamoeba histolytica* cultures with a single bacterial symbiont instead of the usual mixed bacterial flora. However, one encounters difficulties in maintaining consistently an abundant growth level in liquid media. The use of solid media has several inherent disadvantages, the most important of which are the adsorption of the drug being tested on the surface of the solid material and the protection of amebae enmeshed in the suspended solids.

The experiment described in this report, using the bacteria-free Phillips culture (*E. histolytica* strain F 22 with *Trypanosoma cruzi*) (*1, 2*), was initiated in the belief that the use of another protozoan as a symbiont for the ameba would yield a population that would be much easier to observe and control than bacteria. Thus it was hoped that the problem of direct drug action on the amebae would be solved and disadvantages of present *in vitro* screening methods would be reduced. Various known amebicidal and chemotherapeutic agents, including antibiotics, were chosen for the test, and a comparison was made with the Stone's-Locke's egg slant (SLES) culture (*3*) currently in use in this laboratory, and the Phillips culture.

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[2] We wish to extend our appreciation to C. W. Rees, of the National Institutes of Health, for supplying us with the Phillips culture.

TABLE 1

AMEBICIDAL, TRYPANOCIDAL, AND BACTERICIDAL ACTIVITIES *in Vitro* OF SELECTED COMPOUNDS

Drug	(*A*) Phillips (amebae—*T. cruzi*)	(*B*) *T. cruzi* (alone)	(*C*) SLES (amebae-bacteria)	(*D*) Bacterial flora (collectively)	(*E*) Bacteria in SLES medium
Emetine hydrochloride	1: 32,000	Inactive	1: 16,000	Inactive	Inactive
Terramycin hydrochloride	1: 4,000	"	1: 1,000	1: 4,000	1: 2,000
Sulfanilamide	Inactive	"	Inactive	Inactive	Inactive
7-Iodo-5-sulphonic acid–8-hydroxyquinoline (Diodoquin)	1: 1,000	"	"	"	"
7-Iodo-5-chloro–8-hydroxyquinoline (Vioform)	1: 8,000	"	1: 4,000	"	"
p-Carbamino-phenyl-arsonic acid (Carbarsone)	1: 8,000	"	1: 4,000	1: 1,000	"
Penicillin G, sodium	Inactive	"	Inactive	1: 128,000	"
Streptomycin (calcium chloride complex)	"	"	"	Inactive	"
Aureomycin	1: 16,000	"	1: 8,000	1: 4,000	1: 2,000
Chloramphenicol (chloromycetin)	1: 2,000	"	Inactive	1: 16,000	Inactive
Bacitracin	1: 1,000	"	1: 1,000	1: 8,000	1: 2,000

Four tests were run simultaneously with each of the compounds listed in Table 1, using (*a*) the Phillips culture (*E. histolytica–T. cruzi*), (*b*) *T. cruzi* alone, (*c*) the SLES culture (*E. histolytica*–mixed bacterial flora), and (*d*) the four bacterial isolates derived from the SLES flora. Since a regular constituent of the Phillips culture is sodium thioglycollate solution (0.3% diluted 1:6), it was used as a vehicle for the drug dilutions. One hundred mg of each compound was dissolved in 16.7 ml of sodium thioglycollate solution which, at the 1:6 ratio used with other constituents of the Phillips culture, would give a final dilution of 1:1,000. This constituted the highest concentration of the drugs tested, and further dilutions were made serially in multiples of two, covering a range from 1:1,000 to 1 : 128,000, inclusive.

A. The Phillips drug tubes were petrolatum-sealed and incubated 48 hr at 37° C, at which time they were examined through the side walls under the microscope (low power). As a check, a drop of thoroughly mixed fluid from each tube was also examined microscopically to determine what effect the test compound had on the amebae. Subcultures were subsequently made of all negative or doubtful positive dilutions.

B. The *T. cruzi* culture was tested separately by adding 0.2 ml of drug dilution to 1 ml of trypticase *T. cruzi* culture (*1*), thus giving the necessary 1:6 dilution at each concentration. Following incubation for 48 hr at 22°–24° C, samples were examined microscopically for motile organisms. Negative tubes (those with no actively motile organisms) were subcultured into NIH diphasic blood agar medium (*4*).

C. One-ml amounts of pooled material from SLES flask cultures were similarly tested with 0.2 ml of each drug concentration and checked microscopically after 24 hr at 37° C. Subcultures covering the range of doubtfully positive tubes were made in SLES medium.

D. In a similar manner, each bacterial culture was tested, using 5 ml nutrient broth as a medium, inoculating with a loopful from a 24-hr broth culture, and adding 1 ml of each drug concentration. After 48 hr at 37° C the tubes were rated positive or negative for growth, and subcultures were made into nutrient broth.

The values shown in Table 1 represent end points which may be defined as the highest dilution of drug that completely inhibited the growth of the test organism as verified by subculture. In tests where growth occurred at the 1:1,000 dilution, the drugs are considered inactive. Column E represents the drug activities against the bacterial flora within the SLES drug tubes as determined by observed motility. If motile organisms were present at the 1:1,000 dilution the drug was likewise considered inactive.

In almost every test where amebicidal activity was noted, the Phillips culture was, on the average, about twice as sensitive as the SLES culture. The Phillips culture was never *less* sensitive.

There was no instance among the compounds tested where inhibition of the *T. cruzi* occurred, although in six cases (almost all of them antibiotics) inhibition of the bacterial flora occurred (column D). It is noteworthy that considerable variance is apparent between the antibacterial activity in the SLES culture and in broth (columns D and E). The presence of large amounts of solids is probably an important reason for the lowered activity in the former. However, inactivity may have been rated on the presence of only one bacterial species which in itself was incapable of supporting ameba growth. Obviously, judging only by the SLES cultures, it would be very difficult to distinguish direct amebicidal action from indirect action (inhibition of bacterial flora). It is to be expected, however, that compounds may be encountered that would inhibit *T. cruzi*.

In this experiment, all Phillips amebae cultures were observed both through the side walls of the tube directly (*5*) and by microscopic examination of the

contents. Sufficient correlation of the two methods was obtained to deem the drop examination unnecessary. The efficacy of this procedure is supported by the fact that all doubtful tubes (absence of motile trophozoites) were subcultured.

Though a retest of the active compounds failed to reveal any significant variation of end points, the final practicality of the technique as described above will necessarily depend upon more extensive comparison with available *in vitro* methods. On the basis of the results noted thus far, however, the Phillips culture would seem to provide a feasible means for *in vitro* amebicidal screening, reserving a bacteria-amoeba culture for a control check of active compounds.

References

1. PHILLIPS, B. P. *Science*, **111**, 8 (1950).
2. PHILLIPS, B. P., and REES, C. W. *Am. J. Trop. Med.*, **30**, 185 (1950).
3. BOECK, W. C., and DRBOHLAV, J. *Am. J. Hyg.*, **5**, 371 (1925).
4. JOHNSON, E. M. *J. Parasitol.*, **33**, 85 (1947).
5. SHAFFER, J. G., *et al. Am. J. Hyg.*, **47**, 345 (1948).

Changes in the Total Circulating Eosinophile Count in Cyclotron Workers

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Several workers (1–5) have reported eosinophilia in response to x-ray and radium exposure. In 1942 Warren (*6*) reported the blood findings in 4 cyclotron workers who were exposed while sanding a dee. These workers demonstrated an initial fall in white cell count followed by a gradual rise. Of the 3 differential counts reported in this group, 2 had eosinophilia of 4% and 5%.

This report is based upon observation of 3 workers who received an indeterminate exposure while sanding the copper dees of a cyclotron. This exposure consisted of approximately 3 hr on each of 2 successive days. At the end of this period an exposure of 2,400 mr/hour was recorded at a distance of 12 in. from the surface being sanded. Although no pulmonary symptoms were noted following this exposure, inhalation of radioactive dust probably occurred, at least to some degree.

Red and white cell counts, hemoglobins, and differential leukocyte counts at bimonthly intervals prior to this exposure failed to reveal any significant variations. Repetition of these procedures at weekly intervals after exposure revealed only a transient leukopenia, which promptly returned to normal. Determination of the total circulating eosinophiles was made by the technique of Randolph (*7*). All blood counts were taken between 10:00 A. M. and 12:00 noon, without control of the antecedent diet or fluid intake.

Fig. 1 records the variations in the total number of circulating eosinophiles in the exposed and nonexposed personnel. It is evident that workers A and B, who were exposed during the sanding operation, demonstrated a marked increase in the number of total circulating eosinophiles over the nonexposed personnel. Worker C, who apparently had as much exposure as A and B, did not demonstrate the marked eosinophilia shown by the others. It should be noted

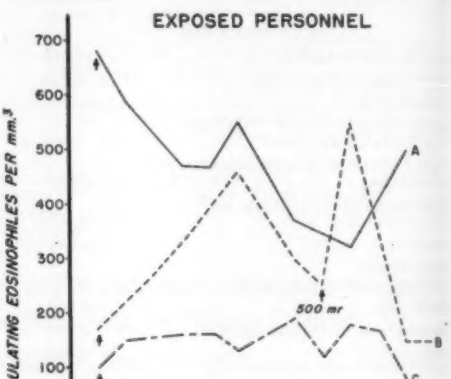

FIG. 1.

that worker A had a high eosinophile count immediately after exposure. Worker B evidenced a gradual increase and decrease in the total number of circulating eosinophiles until the ninth week, when in handling a hot target he received an estimated 500 mr of total-body irradiation. This was followed by a sharp rise in eosinophiles and an abrupt return to normal levels. Although total circulating eosinophile counts were not made prior to exposure, careful survey has failed to reveal any evidence of hypersensitivity or parasitic infestation, and all counts have been entirely normal in the 6 months since the last count recorded in Fig. 1.

It is suggested that the total circulating eosinophile count may be a useful indication of exposure to radiation in individuals employed in x-ray, cyclotron, and other laboratories with radiation hazards.

References

1. MINOT, G. R., and SPURLING, R. G. *Am. J. Med. Science*, **168**, 215 (1924).
2. PHILLIPS, G. W. *Lancet*, **2**, 745 (1933).
3. GOODFELLOW, D. R. *Acta Radiologica*, **17**, 1 (1936).
4. PETERSEN, W. F., and SAELHOF, C. C. *Am. J. Roentgenol.*, **8**, 175 (1921).
5. LAWRENCE, J. S., VALENTINE, N. N., and DOWDY, A. H. *Blood*, **3**, 593 (1948).
6. WARREN, S. *Radiology*, **39**, 194 (1942).
7. RANDOLPH, T. G. *J. Lab. Clin. Med.*, **34**, 1696 (1949).

On the Legality of Restriction of Type Locality

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The restriction of unknown, vague, or multiple type localities to more specific ones has for some years been a common practice among zoological systematists who have concerned themselves with monographic treatments of systematic groups or faunal units. In most instances efforts to determine more exactly the sources of many of the older types have involved investigations that have been as much historical as biological. Dunn (*1*) has suggested several criteria that might be employed in such procedure, and, in the main, type locality restriction based upon revisionary study and historical research has proved useful and generally acceptable. A recent paper by Smith and Taylor (*2*), however, restricting the type localities of some 400 species of reptiles and amphibians, many of which had not been subjected to such investigations, has led us to examine the problem of the legality of all type locality restriction.

The term "type locality" (or "type localities") is used and interpreted here in the usual fashion, i.e., the locality (or localities) where the type specimen (or specimens, syntypes, or cotypes) was actually collected. Usually, but not always, this is given with accuracy and clarity in the original description. In some cases, however, it has been given incorrectly or vaguely, and in such instances the recorded or published statement has no validity as against more precise information as to the actual provenance of the specimen (or specimens) in question. In our experience we have found this usage and interpretation invariable.

Under the general heading "Application of the law of priority" *The International Rules of Zoological Nomenclature* deals in Art. 29 with the division of a genus "into two or more restricted genera;" in Art. 30 with the designation of type species and genera; in Art. 31 with the division of a species "into two or more restricted species," which is "subject to the same rules as the division of a genus," and thus refers back to Art. 29. It might be expected that Art. 32 would deal with the designation of type specimens of species, and refer back to Art. 30, but this is not the case (Art. 32 deals with "rejection of names"), and there is no article on this subject in the *Rules* at all.

In a strict legal sense there are *no* rules or laws in this field; neither type specimens nor type localities are mentioned in the *International Rules*. Thus any and all procedure in this field is equally illegal, or extralegal, and no worker is legally bound by any prior action on the part of others.

If Arts. 29 and 31 are considered together, Art. 31 can be reworded to read: "If a species is divided into two or more restricted species, its valid name must be retained for one of the restricted species. If a type was originally established for said species, the specific name is retained for the restricted species containing said type." The provisions of Art. 31 practically direct that such a rewording be made, and this rewording introduces the term "type" on the species level.

In the absence from the rules of any parallel on the species level to Art. 30, it might be interesting and instructive to concoct one, and especially to create a parallel to Art. 30, Section g, which is the most relevant. Such an altered Section "g" follows.

> *g.* If an author, in publishing a species with more than one valid specimen, fails to designate or to indicate its type, any subsequent author may select the type, and such designation is not subject to change. The meaning of the expression "select the type" is to be rigidly construed. Mention of a specimen as an illustration or example of a species does not constitute selection of a type.

This rewording of Art. 30, Section g, provides a legal basis for the concept of "lectotypes," but this rewording is *not* in the *Rules*. It is not against the spirit of the *Rules* and is frequently in usage in ways varying from precise mention of a single specimen as lectotype, to a vaguer division of a set of syntypes (cotypes) into two or more lots. The procedures recommended by Schenck and McMasters (*3*) and by Simpson (*4*) both consider lectotypes of species as in the spirit of the *Rules* and as sanctioned by usage.

The parallel between the type of a species and the type of a genus is weak in that the first is a material object whereas the second is a concept. Simpson (*4*) expresses his objection to this situation, and we share his objection. It is, however, forced on us by Art. 31 of the *Rules*, and is valid in the sense that in both cases the "types" are the "name-bearers."

Neotypes of genera are not mentioned in the *Rules*. Neotypes of species (not mentioned in the *Rules*) are mentioned by both the articles on procedure noted above, but are not as yet considered legal, nor of common usage.

Type localities of species (not mentioned in the *Rules*) are alluded to in Opinion 52: "The citation of the type locality of a species is not sufficient to establish a name; . . . "the type locality becomes a part of the description and is to be considered an important element in determining the identity of the species."

Just as reexamination of a type specimen may bring to light errors in the original description or characters not mentioned in it, so reexamination of the data accompanying the type specimen or related to it (original labels, collector's notes, or itineraries, etc.) may add precision to or even alter the type locality as given in the original description.

The division of a species "into two or more restricted species" may automatically involve a concomitant selection or restriction of type localities as well as of type specimens—e.g., in the selection of lectotypes in the process of revisionary action. This sort of selection or restriction is not strictly legal (it is not mentioned in the *Rules*), but it is in the spirit of the rules and is sanctioned by usage.

No other selection or restriction of type localities seems to us called for, and no other such restrictions seem to us legally binding on other workers. We therefore regard the restrictions of Smith and Taylor as without legal status ("incompetent, irrelevant, immaterial") and do not consider them as binding on us or other workers.

References

1. Dunn, E. R. *Copeia*, **4**, 167 (1934).
2. Smith, H. M., and Taylor, E. A. *Univ. Kansas Sci. Bull. 33*, Pt. 2, **8**, 313 (1950).
3. Schenck, E. T., and McMasters, J. H. *Procedure in Taxonomy*. Stanford, Calif.: Stanford Univ. Press; New York: Oxford Univ. Press (1948).
4. Simpson, G. G. *Bull. Am. Museum Nat. Hist. 85*, 1 (1945).

The Effect of Distillers' Solubles Containing Fluorine on the Development of Dental Enamel in Swine's Teeth [1, 2]

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This report is the result of a surprise finding of hypoplastic lesions in the enamel of the developing teeth of some swine that were being studied as "normal" animals. The experimental material upon which this investigation was based was obtained[1] in order to make supportive studies of normal development of the teeth and jaws for comparison with a large group of experimental swine. The discovery of developmental defects in well-bred swine that had been raised under ideal conditions pertinent to nutritional experimentation gave emphasis to the desire to find the cause for these lesions. Inasmuch as the animals were raised on a series of high-quality rations for the purpose of observing rate of growth and weight gains, it seemed doubtful that nutritional insufficiency (*1, 2*) would be a likely cause for the lesions. An examination of the rations fed (Table 1) will support this view. Also, since no sickness had been reported in the swine, it was not reasonable to believe that the lesions were the result of infectious processes. The most likely field for investigation seemed to be in relation to effects of some toxic substances that may inadvertently have got into the diet (*3, 4*). An examination of the diets, for the purpose of finding possible toxic substances, led to a consideration of distillers' solubles, which made up 10% of the diet of 5 animals. A discussion of these substances with our associate bacteriologist, J. L. Nemes, who has had personal experience in large distillery operations, led us to consider the possible presence of fluorine in the diets. It is the practice of many large distilleries to incorporate fluorine ($NH_4F \cdot HF$) into the mash during the brewing process in order to inhibit bacterial development (*5, 6*). Since the yeasts have been acclimatized to bifluoride during preparation, this does not interfere with fermentation. In subsequent distillation processes, the fluorine remains in the residue or "slops." These by-products of distillation frequently are used to supplement basal rations fed to livestock (*7, 8*).

The swine obtained for this study were from 26 to 29½ weeks old, 206–225 lbs in live weight, and were equally divided between the sexes. They were well-bred, as indicated in Fig. 1. Mandibles were disarticulated and split at the symphysis. Roentgenograms were made of both sides of each mandible. Primary sections were made for low-power microscopic study by cutting through the undecalcified mandibular teeth and bones by means of high-speed cutting disks, as previously described (*9*). These sections, 0.5–1.5 mm in thickness, were studied under reflected light through a research binocular microscope. There were 9 permanent first molar teeth included in the sections and 10 developing second molar teeth, all from the right half of the mandibles. Other histologic sections were made from decalcified, celloidin-embedded tissue, for high-power microscopic study. The celloidin sections included 5 developing second molar teeth.

Roentgenograms of the mandibles showed no changes in periosteal bone formation similar to those reported as resulting from fluorine intoxication (*10*). There were some irregularities in bone density, but this followed no characteristic pattern. The development of the teeth and jaws was as nearly equal among these swine as one would expect considering their variation in age.

The primary sections revealed developmental defects in enamel formation that ranged from a complete break in the contiguity of enamel in 2 second molar teeth (Nos. 278 and 7,675) to a mere thinning or gnarling of the enamel in a number of the others. A diagrammatic illustration of these changes is shown in Fig. 1. It was observed that only 1 first molar tooth (No. 7,823) contained a developmental fault. The characteristic region which seemed susceptible to developmental interference was an area about one third the distance from the occlusal surface, on the buccal aspect of the second molar teeth. Seven of the swine showed some irregularities in the architectural pattern of the enamel in this region, but animals 271, 278, and 7,675 were outstanding in this respect. Other irregularities were noted on the occlusal surfaces of 5 swine. A low-power picture of a developing second molar tooth with typical hypoplasia of the buccal and occlusal surfaces is shown in Fig. 2. A high-power photomicrograph of a hypoplastic lesion observed in the enamel of swine No. 271 is shown in Fig. 3. In this animal there was some enamel covering the dentin over all the tooth shown, but there was a definite fault over the buccal surface. Similar lesions were observed in

[1] Eleven swine heads were obtained from the Agricultural Research Center, Bureau of Animal Industries, USDA, Beltsville, Md. Ten of these were sectioned for study. We are indebted to John H. Zeller and N. R. Ellis, of the Bureau, for assistance in obtaining the swine tissue, feed samples, and the data on nutrition and swine characteristics of Table 1.

[2] Acknowledgment is made of the fluorine analysis of feeds done by the Food Division of the Food and Drug Administration.

[3] CDR, DC, USN. The opinions or assertions contained herein are those of the writer and are not to be construed as being official or as reflecting the views of the Department of the Navy or the naval service at large.

TABLE 1

Hog No.	Sex	Breed	Sire	Dam	Age (weeks)	Live shrunk wt at slaughter	Ration fed*	Presence of lesions	
								Primary section	Celloidin section
271	M	Crossbred	L-D-H	L-LB	27	212 lb	B	++++	+++
276	F	"	"	"	27	213	B	++++	
278	F	"	"	"	27	225	B	++++	++
318	F	"	"	Y-D-L-H	26.5	210	E	–	+
7,975	F	Landrace-Duroc Hampshire			26.5	221	C	–	
7,675	F	Chester White-Landrace			29.5	206	B	–	
7,823	M	Landrace			28.5	212	B	+++	
7,934	M	Yorkshire-Duroc-Landrace-Hampshire			27	216	A	++	+
7,983	M	Landrace			26.5	206	E	–	
8,013	M	Landrace-Duroc			26	216	C	–	

* The composition of the various rations follows. These are considered high-quality rations.

Ration	A	B	C	E
Yellow corn	68.5	66.0	69.5	70.0
Soybean meal	12	10.5	24.	10.5
Meat and bone scrap	7.	7.		
Alfalfa meal	7.	5.	5.	6.
Linseed meal	6.			6.
Corn distillers' soluble		10.		
Mineral	1.5	1.5	1.5	1.5
Vitamin B_{12} concentrate			2.1 mg/100 lb	
Tankage				3.0
Fishmeal				3.0

Protein content of rations A, B, C,—17.5 to pigs from 30 to 125 lbs
" " " " " —14.5 " " " 125 lbs to slaughter wt

animal No. 278. Table 1 includes a listing of lesions observed.

Three samples of distillers' solubles used in preparing the ration fed to hogs that received ration B were obtained from the Agricultural Research Center, Beltsville, Md. These samples were analyzed for fluorine by

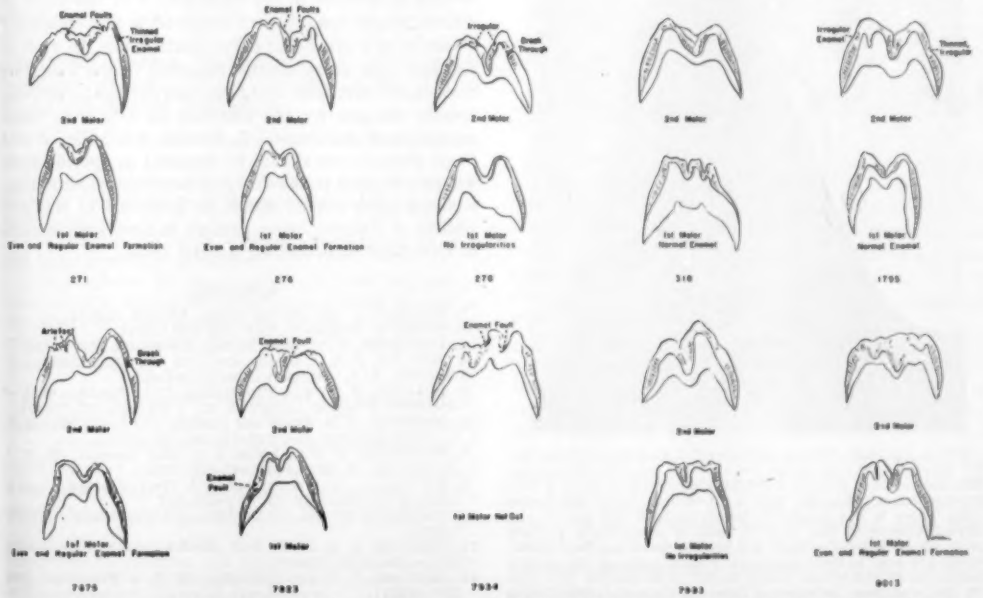

FIG. 1. Diagrammatic illustration of enamel formation in teeth of 10 hogs raised on varied high-quality rations.

the Food Division of Food and Drug Administration. The results are shown in Table 2. The malt process and fungal amylase process solubles were processed by one distillery for a special study conducted by the Beltsville Agricultural Research Center, and the composite sample was made up of equal parts of solubles obtained from four of the leading distilleries of the country.

The observations reported herein were made on tissues from 10 swine on varied diets, and a chemical analysis was made of one component which formed 10% of the diets of 5 animals. The distillers' soluble component of the diets was analyzed for fluorine because the lesions observed were suggestive of a toxic response and because of evidence that bifluoride is sometimes used as a bacterial inhibitor in brewing processes. Inasmuch as this investigation was not planned or specifically controlled for the purpose of relating these substances to toxic effects, the actual finding of fluorine in the rations of 5 of the swine in which serious lesions were observed is not conclusive evidence of a cause-and-effect relationship. In view of the fact that many studies reported in the literature have shown that teeth and bones are subject to developmental changes by the addition of relatively small quantities of fluorine (*3, 7, 10–13*), it is believed that these observations should be reported as specific cases wherein fluorine in the diet may be a factor. Nutritionists and stock raisers should be informed of the possibility of fluorine being present in feed supplements in quantities approaching a toxic level.

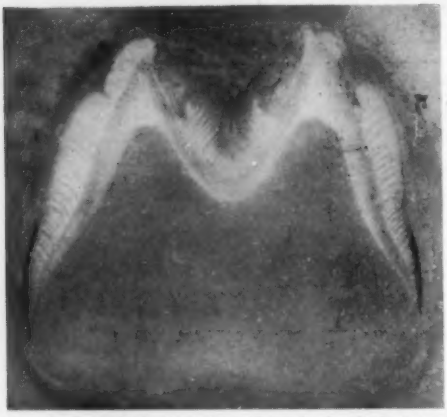

FIG. 2. Buccolingual section through developing second molar tooth, hog No. 271. Break in contiguity of the enamel on the buccal and occlusal surface of this tooth leaves an area of dentin entirely denuded. Inferior to the developmental defect the enamel appears to be normal. No abnormality in the dentin or pulp is evident. (× 21.)

FIG. 3. Celloidin section, hematoxylin and eosin, of decalcified developing second molar tooth, swine No. 271. Decalcification has removed most of the highly inorganic enamel. A thin band of enamel remains over most of the tip of the buccal cusp. There is a hypoplastic lesion on both the buccal and lingual aspects of this cusp. A band of ameloblasts outlines areas where normal enamel has been present, but few ameloblasts are seen in the hypoplastic region. Cells of the stellate reticulum fill the lesion, which is devoid of enamel. The dentin has prominent imbrication lines approximately paralleling the amelodentinal junction. (× 5.)

TABLE 2

Sample No.	Origin of sample	Animals receiving this ration (No.)	F as fluoride (ppm)
I	A malt process corn distillers' soluble	271	
		276	
		7,675	115
II	Fungal amylase process soluble	7,823	224
III	A composite sample of corn distillers' solubles	278	24

References

1. KLEIN, J. *J. Am. Dental Assoc.*, **18**, 866 (1931).
2. BOYLE, P. E. *Am. J. Path.*, **14**, 843 (1938).
3. MCCOLLUM, E. V., *et al. J. Biol. Chem.*, **63**, 553 (1925).
4. ENGLISH, J. A. *J. Dental Research*, **28**, 172 (1949).
5. NEMES, J. L. Personal communication.
6. WILLKIE, H. F., and PROCHASKA, J. A. *Fundamentals of Distillery Practice.* Louisville, Ky.: Seagram 57 (1943).
7. MORRISON, F. B. *Feeds and Feeding* (20th ed.) Ithaca, N. Y.: Morrison Pub. Co., 113–14, 348–50 (1945).
8. FAIRBANKS, B. W., KRIDER, J. L., and CARROLL, W. E. *J. Animal Sci.*, **3**, 29 (1944); **4**, 420 (1945).
9. ENGLISH, J. A., and TULLIS, J. L. Oral Manifestations of Ionizing Irradiations. To be published.
10. BAUER, W. H. *Am. J. Orthodontics Oral Surg.*, **31**, 700 (1945).
11. MCCLURE, F. J. *U. S. Pub. Health Service Pub. Health Repts.*, **64**, 1061 (1949).
12. MCCLURE, F. J., and MITCHELL, H. H. *J. Biol. Chem.*, **90**, 297 (1931).
13. SCHULZ, J. A., and LAMB, A. R. *Science*, **61**, 93 (1925).

Effects of a Supranormal Diet of Glutamic Acid on the Test Performance of Paretics[1]

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An experiment by Albert, Hoch, and Waelsch (*1*) has given a basis for the hypothesis that secondary mental defect may be improved under glutamic acid medication. This hypothesis has been formally stated by Ruth Woods (*2*), who also cited supporting studies (*3–5*):

> In other words, it is believed that glutamic acid, a substance affecting brain metabolism, probably aids patients whose intellectual potentialities were basically normal, but have been damaged by brain disease or injury, or inhibited by emotional mechanisms.

Attention should be called to at least three aspects of the Albert, Hoch, and Waelsch experiment (*1*). In the first place, the size of the sample ($N = 8$, with 2 dropped later) was too small for secure conclusions. Second, the diagnosis of secondary mental deficiency was not well established. The authors (*1*) stated that "in some of our patients the diagnosis was not certain." Third, although possible suggestion effects were taken care of by the use of placebos, it is not clear whether it was known to the testers which patients received the placebo and which the glutamic acid. It is our presumption that the test administrators knew the medication schedule of each subject. This knowledge might well be a biasing factor.

The present experiment was undertaken in an effort to avoid these difficulties in testing the hypothesis that glutamic acid may benefit patients with secondary mental dysfunction. The syndrome chosen for study was general paresis. This offered the following advantages pertinent to our criticism of the Albert, Hoch, and Waelsch experiment:

1. A reasonable number of subjects was available for examination.
2. A clear-cut, reliable diagnosis could be established, insuring the group to be homogeneous with respect to basic pathology.
3. Brain damage could be clearly established to exist and to be secondary in nature.
4. A possibility for improvement remained even though some previous therapeutic measures had failed. Studies of the effects of other therapies on the mental functioning of paretics suggested the possibility of reversing the usual downward trend (*6, 7*).

The subjects selected for study were 46 institutionalized white male veterans of World War I, diagnosed as follows: syphilis, tertiary, meningoencephalitic manifested by psychotic reaction, general paresis. All were patients in the Veterans Administration Neuropsychiatric Hospital, Palo Alto, and ranged in age from 49 to 59. Not included in the sample were patients with mixed diagnoses that might conceivably distort test results by reason other than primary diagnosis. In addition, no case was included that had not been formally reviewed by the medical staff in a diagnostic conference at least twice after the original formulation had been made. The sample chosen was further curtailed in that only patients who produced a scorable response for at least 9 of the initial 11 subtests of the Wechsler-Bellevue Intelligence Scale were included.

Of the 46 subjects, 18 were dropped during the course of the experiment for the following reasons: 6 refused medication, 5 became disturbed and untestable, 3 were transferred to other institutions, 3 became physically ill for reasons extraneous to the study, and 1 left the hospital on a trial visit. Table 1 gives the educational performance of the group.

TABLE 1

ATTAINED EDUCATIONAL LEVEL*

No. subjects	Elementary school grade
1	2
1	3
	4
1	5
2	6
3	7
7	8
	High school grade
2	9
3	10
	11
5	12
	College year
	1
1	2
	3
2	4

* The median level of educational attainment is completion of the eighth grade, which is the same as Wechsler's normals (*9*).

The entire original group was tested with the Wechsler-Bellevue Intelligence Scale prior to medication. Forms I and II (*8, 9*) were used alternately in this first situation and then later re-alternated in the re-test situations to minimize practice effects. All tests were administered by four Veterans Administration clinical psychology trainees who were not acquainted with the hypotheses or the design of the study.

All the patients in the sample were assigned initial treatment with natural dextrorotatory glutamic acid or a placebo on the basis of selection from a table of random numbers (*10*). The dosage was 12 g daily. The placebo was especially manufactured by a pharmaceutical firm to be identical in size, shape, and weight with the glutamic acid tablet. The taste was carefully copied, also, but the resemblance although close was not perfect. Since no patient could taste both kinds of tablet at the same time, this lack of absolute similarity was thought not to be a serious hindrance.

[1] Published with permission of the chief medical director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.

TABLE 2

MEANS AND SIGMAS IN WECHSLER-BELLEVUE IQs FOR THE THREE TESTING PERIODS

	Initial test	Initial treatment	First re-test	Second treatment	Second re-test
Experimental group A $N = 15$	M = 81.53 σ = 12.25	Glutamic acid	M = 79.13 σ = 11.48	Placebo	M = 81.00 σ = 12.77
Experimental group B $N = 13$	M = 87.69 σ = 11.77	Placebo	M = 84.77 σ = 13.37	Glutamic acid	M = 87.69 σ = 13.79

All medication was dispensed by a centrally located pharmacy on a physician's (FEB) individual prescription. At this pharmacy, in order to preserve the confidential nature of the medication schedule, the bottles containing the pills were labeled *A* and *B*. Thus, the nurses and aides who actually dispensed the tablets to the patients did not need to know which patient was receiving the actual medication and which the placebo. The therapy schedule, therefore, was known only to the pharmacist and the experimenters, none of whom was involved in the testing.

After two months of this type of dosage, medication was halted and re-testing was begun. This consumed a period of 21 days; during this time no medication was administered. With testing completed, treatment procedure was again begun. Those patients previously receiving placebo tablets now received a daily 12-g dose of glutamic acid, and those previously on glutamic acid received an equal number of placebo tablets. After two months, medication was again halted and a second re-testing was done.

Table 2 summarizes the test results in chronological order.

The significance of the differences between the means of groups A and B was determined for the initial testing, the first re-testing, and the second re-testing. In addition, the significance of the differences between the means for initial testing and first re-testing and between the first and second re-testing was determined for each of the groups.

None of the changes approaches significance. All differences are within the error of the instrument. As a result, the following conclusions seem evident:

1. The use of glutamic acid to restore mental capacity does not work with chronic paretics of the ages tested.
2. Only two patients gained as much as 10 IQ points. One gained it on glutamic acid medication, and the other gained it on placebo medication.
3. There was no downward trend in the test scores as the date of the end of medication became more remote.

References

1. ALBERT, K., HOCH, P., and WAELSCH, H. *J. Nerv. Mental Disease*, **104**, 263 (1946).
2. WOODS, R. *Borden's Rev. Nutrition Research*, **9**, (7), 1 (1948).
3. PRICE, J. C., WAELSCH, H., and PUTNAM, T. J. *J. Am. Med. Assoc.*, **122**, 1153 (1943).
4. WAELSCH, H. *Am. J. Mental Deficiency*, **52**, 305 (1948).
5. WEIL-MALHERBE, H. *Biochem. J.*, **30**, 665 (1936).
6. DU BOIS, P. H., MAYS, L. L., and LANDIS, C. *Psychiat. Quart.*, **8**, 699 (1934).
7. EPSTEIN, S. H., and SOLOMON, R. C. *Am. J. Psychiat.*, **95**, 1181 (1939).
8. WECHSLER, D. *Measurement of Adult Intelligence* (3rd ed.). Baltimore: Williams & Wilkins (1944).
9. WECHSLER, D. *The Wechsler-Bellevue Intelligence Scale. Form II Manual for Administering and Scoring the Test.* New York: Psychological Corp. (1946).
10. FISHER, R. A., and YATES, F. *Statistical Tables* (3rd ed.). New York: Hafner (1948).

An Improved Apparatus for Measuring the Electrogastrogram[1]

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In order to record more detailed data of the electrogastrogram we have evolved an improved apparatus as a further development and refinement of that used in the report of one of us (ENG) in November 1942 (*1*).

The present apparatus consists of a Miller-Abbott tube containing an intragastric electrode of .01-gauge pure silver wire with a fused bead 1–2 mm in diameter at its gastric end. This bead is chloridized, and the system made watertight by sealing with polythene cement. The other lumen of the Miller-Abbott tube is fitted with a latex balloon and attached to a strain gauge. The arm electrode consists of a helix of .025-gauge silver wire, chloridized, and placed within a glass bell (Fig. 1).

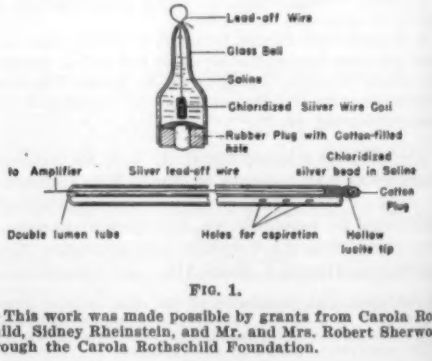

FIG. 1.

[1] This work was made possible by grants from Carola Rothschild, Sidney Rheinstein, and Mr. and Mrs. Robert Sherwood, through the Carola Rothschild Foundation.

The recording instrument consists of a G-E Photoelectric Potentiometer Model 8CE5 (Fig. 2). This instrument has a current consumption of .01 ma at balance position and a full-scale response time of 0.3–0.4 sec. It was found that our recorder would not operate with direct leads from our patients because the source impedance was high and there was insufficient dampening of the galvanometer. An impedance-changer in the form of a double triode amplifier operating with an input impedance of 10^7 ohms is used. The amplifier is d-c-operated, is built in conjunction with a millivoltmeter, and has a gain of approximately 5.3. An additional advantage is the further reduction in current consumption imposed on the source of the potential being measured.[2]

The mechanical recordings are obtained with the aid of a pressure-operated strain gauge, the metal bellows of which is fed from the lumen of the Miller-Abbott tube leading from an intragastric balloon. The output of the strain gauge is, in turn, fed into a G-E Photoelectric Potentiometer Recorder identical with that used for the electrical recordings. Both the recorder from the electrical side and that from the mechanical side are synchronized so that the total electrical activity and total mechanical activity of the stomach are synchronously and continuously recorded (Fig. 2).

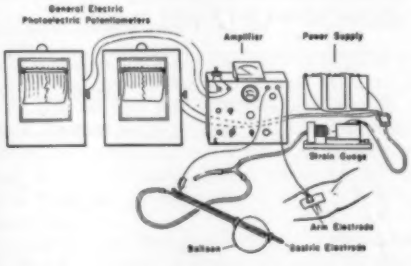

FIG. 2.

The above-described apparatus has the following advantages over that employed in the earlier work:

1. The recording instrument provides a continuous record instead of a connected series of spot-checks.
2. A full-scale deflection time of 0.3–0.4 sec instead of one of 28 sec.
3. The substitution of the stable silver-silver chloride electrode system for the calomel half-cell system.
4. The use of a long silver conductor instead of the liquid column conductors with their variable high resistance. This modification also dispenses with a large number of liquid interfaces.
5. The greatly lowered current consumption from the source being measured.
6. The inclusion of a method for accurately measuring synchronous variations in intragastric pressure.

Using the above apparatus we have recorded the electrical potential patterns from stomachs of normal subjects and of documented cases of duodenal and

[2] Purchased from H. S. Burr, Sterling Hall, New Haven, Conn.

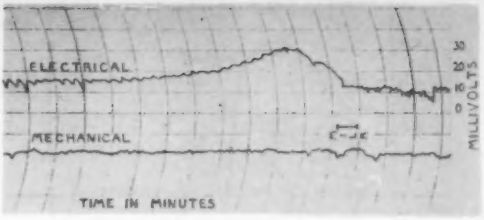

FIG. 3.

gastric ulcer, gastric carcinoma, and atrophic gastritis. Certain noteworthy facts are revealed regarding both normal gastric physiology and the electrical and mechanical behavior of diseased stomachs, which will be reported in detail in a subsequent paper.

Sixty-three determinations were performed on normal subjects. Fig. 3 show a typical pattern, with the upper line representing the electrical, and the lower line the mechanical, activity. The general characteristics of this group are:

Electrical: (1) A fairly regular baseline in rhythm, rate, and amplitude. The rhythm varies from 3–12/min with an amplitude of approximately 4–6 mv. (2) The milk response is immediate with increase in negativity, and dampening of amplitude.

Mechanical: (1) A fairly regular baseline corresponding to the electrical in rate, rhythm, and amplitude. (2) No appreciable change in baseline or amplitude with the ingestion of milk.

Reference

1. GOODMAN, E. N. *Surg. Gynecol. Obst.*, **75**, 583 (1942).

False Absorption Bands in the Region of 200–230 mμ Caused by Stray Radiation in the Beckman Spectrophotometer

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Although most textbooks on spectrophotometry discuss errors caused by stray radiation, it is believed that the manifestations of these errors and their seriousness are not realized by many research workers in biology and chemistry, who are now using the Beckman Model DU spectrophotometer in the far ultraviolet region, where stray radiation is appreciable. Moreover, of those who are aware of the danger, many simply evade it by limiting their observations to the region above 220 mμ or by rejecting absorbancy[1] readings above a certain limit (*1*). Neither of these practices alone insures against false results, apart from the fact that the first practice may lead one to overlook important information, and the other may be inconvenient.

The effect of stray radiation in the region of 200–

[1] The terms are defined in *Natl. Bur. Standards Circ. (U. S.)* **484** (1949).

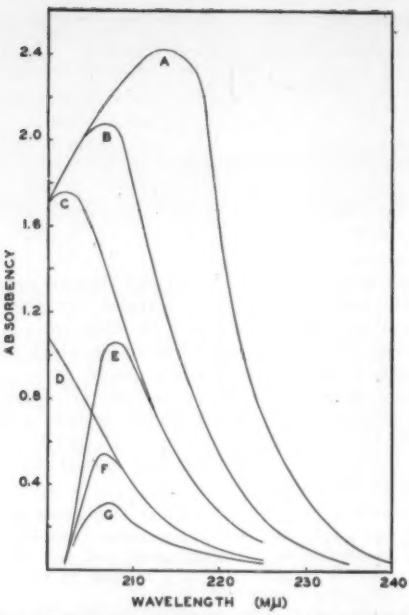

FIG. 1. Uncorrected absorption curves for glycine in water, curves *A–D*, and in 0.5 *M* phosphate buffer, pH 6.6, curves *E–G*. The concentration of glycine was, for curve *A*, 0.2 *M*; for curve *B*, 0.067 *M*; for curve *C*, 0.033 *M*; for curve *D*, 0.013 *M*; for curve *E*, 0.033 *M*; for curve *F*, 0.013 *M*; and for curve *G*, 0.0067 *M*.

230 mμ on the absorption curves of compounds that absorb in this region (and this includes practically all compounds to some degree) will be illustrated in the following discussion. No attempt will be made to give a general treatment of stray radiation, as this has been extensively covered in the literature (*2*).

All absorption data, unless otherwise indicated, were obtained with a Beckman Model DU spectrophotometer, serial No. 1146, in which the load resistor in the phototube housing had been changed from 3,000 megohms to 10,000 megohms in order to permit readings at 200 mμ. When experiments were first undertaken, it was observed that water solutions of any compound that absorbed appreciably in the region around 200 mμ displayed an absorption maximum if sufficiently high concentrations of the compound were used. The maximum occurred at wavelengths as high as 240 mμ and at absorbancy readings as low as 0.45. Examination revealed that the collimating mirror was fogged. In curves *A–D* of Fig. 1, however, absorption data are plotted for solutions of glycine in water which were obtained after the mirrors were resilvered, and the instrument was carefully cleaned and checked by the manufacturer. The solutions were read in 10-mm silica cuvettes against a water blank. That the observed maxima are false was demonstrated by the following observations: (1) According to Ley and Arends (*3*), who employed a vacuum spectrograph, glycine has no absorption maximum in the region from 185 mμ to 235 mμ. (2) When the solution from which curve *B* was obtained was run on a Cary spectrophotometer, again no maximum was found in this region.[2]

Since curve *D* plotted from absorbancy values lower than 1.2 contained no maximum, one might consider this a safe upper absorbancy limit. However, the danger of selecting any arbitrary absorbancy limit is illustrated by curves *E–G* of Fig. 1, obtained with solutions of glycine of different concentrations in 0.5 *M* phosphate buffer of pH 6.6 in 10-mm silica cuvettes. Again the maxima are all false—even the one plotted from absorbancy values lower than 0.35. The explanation lies partly in the high absorbance of the solvent which, read against an empty compartment in the cuvette holder, had itself a value of about 1.4 at 205 mμ. Yet purified ethyl alcohol has been reported (*4*) as having an extinction coefficient corresponding to an absorbance in a 10-mm cell of about 2.0 at 200 mμ, and a 0.1 *M* solution of reagent-grade sodium hydroxide in water has been found to have an absorbance in a 10-mm cell > 2.0 at 215 mμ. These are both solvents commonly used in ultraviolet spectrophotometric work. The absorbancy values from which curves *E–G* were plotted were obtained by subtracting solvent absorbances from the solution absorbances. This is equivalent to the general practice of reading the solution against the solvent as blank.

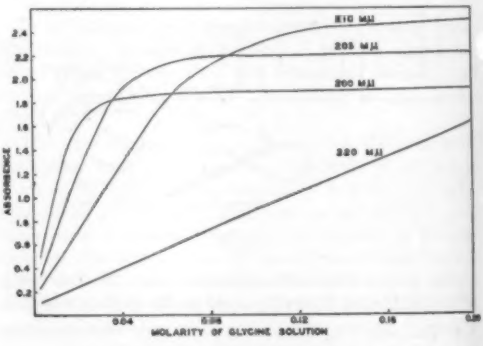

FIG. 2. Glycine in water.

In Fig. 2 the absorbance of glycine in water is plotted as a function of glycine concentration at several different wavelengths. Similar curves would be obtained with any compound that absorbs in this region and is transparent at higher wavelengths. Such a curve shows at a glance which absorbance readings must be rejected at each wavelength and provides a method for correcting the acceptable absorbance readings which are also in error.[3] Assuming Beer's law holds over this range of concentrations, a straight line of positive slope should have resulted at all wave-

[2] The authors gratefully acknowledge their appreciation to W. A. Holmwood and H. W. Alter, of General Electric Laboratories, for this information.

[3] The authors are indebted to T. Parke, of Lilly Research Laboratories, for helpful discussions, suggesting this type of correction for stray radiation.

lengths. Instead, it may be seen that the 200 mμ curve approaches linearity only at absorbance values up to about 1.4, the 205 mμ curve up to about 1.8, and the 210 mμ curve up to about 1.9. Absorbances below these values may be corrected; those above must be rejected. In this region where the solvent absorbs appreciably, it is advisable to read and correct solution and solvent absorbances separately.

To make corrections, it is necessary first to estimate stray radiation. This can be done by making use of the expression $A = \log \frac{I_{o\lambda} + I_{os}}{I_\lambda + I_s}$, where A is the observed absorbance, $I_{o\lambda}$ is the intensity of the incident monochromatic radiation, I_{os} is the intensity of the incident stray radiation, I_λ is the intensity of the transmitted monochromatic radiation, and I_s is the intensity of the transmitted stray radiation. The nearly horizontal portion of the curves in Fig. 2 represents a condition where the concentration of the absorbing substance, i.e., glycine, is so great that the transmitted monochromatic radiation is effectively zero, $I_\lambda = 0$, whereas the stray radiation, which comes from higher wavelengths, is almost completely transmitted, $I_{os} = I_s$. Therefore, over this portion of the curve, approximately, $A = \log \frac{I_{o\lambda} + I_{os}}{I_{os}}$, from which it is apparent that the ratio of incident stray radiation to total incident radiation, $\alpha = \frac{I_{os}}{I_{o\lambda} + I_{os}} = \text{antilog}\ (-A)$, where A is best taken as the intercept of this portion of the curve with the ordinate. Thus, at 200 mμ $\alpha = 0.014$; at 205 mμ $\alpha = 0.007$; and at 210 mμ $\alpha = 0.005$. The values have been found to vary from instrument to instrument and from time to time, depending on several factors, among which are the condition of the mirrors and the intensity of the hydrogen discharge lamp.

It is evident that the stray radiation increases with decreasing wavelength. It is this property of the instrument which, in spite of such very small amounts of stray radiation, produces the dip in the absorption curve in a region where it should be rising. For, with the monochromatic light almost completely absorbed, the instrument essentially records only the increase in stray radiation with decreasing wavelength.

Once α has been determined, corrections may be made by means of a table (*5*) or the following equation: $A' = \log \frac{1 - \alpha}{T - \alpha}$, where A' is the corrected absorbance and T is the experimentally observed transmittance = antilog $(-A)$.

The above considerations have permitted the safe extension of the working range of the Beckman spectrophotometer down to 200 mμ. Because so many different compounds have an appreciable and characteristic extinction coefficient around 200 mμ, it is believed that the region has important analytical possibilities that have been almost completely neglected thus far. Studies on proteins, peptides, amino acids, and related compounds have already been initiated with interesting and useful results to be published soon.

References

1. Doud, L., and Vandenbelt, J. M. *J. Am. Chem. Soc.*, **69**, 2714 (1947).
2. Hogness, T. R., Zscheile, F. P., Jr., and Sidwell, A. E., Jr. *J. Phys. Chem.*, **41**, 379 (1937).
3. Ley, H., and Arends, B. *Z. physik. Chem.*, **B17**, 177 (1932).
4. Klevens, H. B., and Platt, J. R. *J. Am. Chem. Soc.*, **69**, 3055 (1947).
5. Opler, A. *J. Optical Soc. Am.*, **40**, 401 (1950).

Electron Microscope Study of Epidermal Fibers[1]

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For many years the status of intracellular fibrils in the stratum spinosum of human skin has been much debated. Their appearance has been sketched by Rio Hortega (*1*) who represented them as extensions of the intercellular bridges. Chambers and Renyi (*2*), however, working with living material and a micromanipulator, found no evidence of intracellular fibrils and concluded that the fibrils were an artifact of fixation.

The present results were derived from normal human skin, preliminary to a study of pathological changes. Samples were obtained by punch-biopsies, the punch used being 1 mm in diameter. The samples, approximately 1 mm × 1 mm, were immediately put into 2% osmic acid and fixed for 24 hr. After washing and conventional alcohol dehydration, they were double-embedded in celloidin and hard paraffin. The celloidin was gradually increased in concentration to 12% and finally hardened in chloroform. Conventional paraffin immersion completed the embedding. The samples were oriented in plastic blocks so that cutting would be at right angles to the skin surface. Thin sections (0.1 μ) were cut on a modified Spencer microtome (*3*) and mounted on 200-mesh copper screens after extracting the paraffin and most of the collodion.

The results of many views of the stratum spinosum from a number of independent samples taken mostly from the upper arm are typified in Fig. 1. Intercellular bridges are clearly evident and appear to terminate at the cell boundaries, although no definite conclusions can be drawn as to whether they are protoplasmic in structure. On close view the precipitated cytoplasm also exhibits a fine feltwork of fibers, but they are of a different order of size than the intracellular fibers which have been described and furthermore are laid down in a random manner hav-

[1] Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

FIG. 1. Electron micrograph of 0.1-μ section of human epidermis (×3540).

ing no apparent relation to the intercellular bridges. The diameter of these fine fibrils in the cytoplasm is more than likely a function of the fixative used, and is at a minimum for osmic acid.

Two interpretations of the intracellular fibers seen in light-microscope preparations suggest themselves. Experience with fixatives other than osmic acid indicates that the size of the precipitated proteins (meshwork) is often of the same order of magnitude as the fibrils that have been described, and the general visual effect when viewing an ordinary stained section at one focal level would correspond to an appearance of fibrils against a smooth out-of-focus background. But the most likely interpretation is that in any section containing more than a single layer of cells one gets a very definite impression of fibrils as a result of intercellular bridges lying just above or below the plane of focus. Such artifacts arising from the limited depth of field of the light microscope are probably more numerous than is commonly realized. The use of very thin sections with the electron microscope has the disadvantage that it becomes difficult to follow structures that do not lie exactly in the plane of the section, but the large depth of field in the object space, which is characteristic of electron optics, serves to counterbalance this disadvantage to a great extent.

It must be added that preliminary work with pathological material has confirmed a previously recognized fact; namely, that there is a great proliferation of fibers throughout the epidermis. Only with such preparations have intracellular fibers been seen in thin sections.

References

1. RIO HORTEGA. *Trabajos lab. invest. biol., Univ. Madrid*, 15, 201 (1917).
2. CHAMBERS, R., and RENYI. *Am. J. Anat.*, **35**, 385 (1925).
3. PEASE, D. C., and BAKER, R. F. *Proc. Soc. Exptl. Biol. Med.*, **67**, 470 (1948).

Effect of Hibernation upon Survival Time following Whole-Body Irradiation in the Marmot (*Marmota monax*)

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The relationships between reduced body temperature, lowered metabolism, and rate of development of the toxic effects of radiation have hitherto been little studied among mammals. The rate of development of the lethal processes following irradiation is reduced by lowered environmental temperature in frogs (*1*). Similar results have been obtained with chick embryos (*2*) and amphibian eggs (*3*). The reduced metabolic rate that resulted from chilling the irradiated frogs was accompanied by an increased survival time, but no reduction in mortality was observed. Increased metabolic rate resulting from thyroid administration has been found to coincide with an increased mortality in mice following irradiation (*4*). On the other hand, the administration of antithyroid substances, which reduce the metabolic rate, does not alter radiation lethality nor increase the survival time in irradiated mice (*5*).

The metabolic rate in the hibernating marmot averages only about one third that found in the nonhibernator (*6,7*). Marmots were selected for the experiments reported here in order to find out whether sensitivity to radiation would be lower in the hibernator than in the nonhibernator.

Two groups of marmots, equally matched as nearly as possible with respect to number, age,[1] and sex were used for the experiment. The animals of one group were allowed to hibernate in a constant-temperature room held at 3.5° C ± 0.5° C and were irradiated 3 weeks after the onset of deep hibernation. The other group was maintained at room temperature and served as nonhibernating, irradiated controls. The nonhibernating marmots were given 550 r, which was previously found to be approximately the LD_{100}. Higher doses, 650 r and, in one case, 800 r, were given to the hibernating marmots to accentuate a possible decreased radiation sensitivity in the hibernating phase.

[1] Roy Grizell, in a personal communication, kindly provided information, accumulated from several seasons of trapping, indicating that up to about 4 kg these animals increase in weight at a rate roughly equivalent to 1 kg/yr.

TABLE 1

WEIGHT CHANGE AND MORTALITY IN IRRADIATED HIBERNATING MARMOTS

No.*	Sex	Average wt before hibernation (g)	r	Days in hibernation after r	Average wt loss after r (hibernating) (g/day)	No. surviving	Days of survival after end of hibernation	Average total survival time (days) of those dying after r
2	♂	1,430	650	28, 28	3.9	1	14.0	42
3	♀	1,946	650	*a*)33, *b*)35, *c*)30	6.6	0	*a*)6, *b*)10, *c*)7	40
2	♂, ♀	2,250	650	♂ 42, ♀ 38	5.7	0	♂ 9, ♀ 4	46
1	♀†	4,120	800	21	14.0	0	(died in hib.)	21

* One animal was aberrant in that it required 72 days in the cold before the onset of hibernation. This marmot died in hibernation at 14 days after irradiation (650 r) and is not represented in the table.

† This animal, included here for convenience, was given 800 r.

Nine marmots, whose mean weight was 2.4 kg, were caged singly and provided with shredded wood for nesting purposes. A combination of low temperature, reduced food supply, darkness, and a minimum of disturbance aided in initiating and maintaining hibernation throughout the experiment. Four marmots were removed from hibernation and returned to room temperature, 2 at 28 days and one each at 35 and 42 days after irradiation. Of the other 4 hibernating marmots given 650 r, one died in hibernation at 14 days after irradiation and 3 spontaneously terminated hibernation and had to be returned to room temperature on the days indicated in Table 1.

Nine nonhibernating control animals averaging 2.2 kg in weight were singly caged, maintained at room temperature of about 27° C, and were given 550 r. One additional marmot which did not enter hibernation even after 70 days in the cold was given 650 r and returned to the cold room (Table 2).

Irradiation was carried out at the rate of 49 r/min with a 200 kvp x-ray unit with 0.08 mm copper added filtration and at a target distance of 70 cm. One half the dosage was applied to each side of the animals. An especially constructed plywood box provided with a device that prevented the animal from rotating was used for the nonhibernators. Care was taken to avoid unnecessary warming of the hibernators at any time. Heavy gloves were worn while handling these animals, and a stream of chilled air was passed over them during irradiation.

Weekly measurements of rectal temperatures averaged 4.4° C during 58 days of hibernation in 2 nonirradiated marmots, whereas the mean rectal temperature in nonhibernating marmots is about 36.5° C.

The marmots completing 28–42 days of hibernation after 650 r survived 40–45 days, as shown in Table 1, compared with a survival time of only 18–27 days for the nonhibernators given 550 r (Table 2). One hibernator recovered and one died in hibernation at 14 days after irradiation (650 r), and 3 nonhibernators recovered. Increases in the length of hibernation time after irradiation did not result in corresponding increases in posthibernation survival time. The differences between posthibernation survival time and the survival time of nonhibernators may be attributed either to the higher radiation dose given the hibernators or to damage accumulating during hibernation or to both these factors.

Weight loss in the hibernating marmots given 650 r averaged 5.6 g/day (range 2.7–8.8 g) during the period between irradiation and the end of hibernation, compared with an average weight loss of 9.2 g/day (range 3.3–15.5 g) during the first 18 days after irradiation in 7 nonhibernators; gains in weight occurred during this period in 2 other nonhibernators. Weight loss averaged 3.0 g/day for 2 nonirradiated control marmots during 58 days of hibernation.

TABLE 2

WEIGHT CHANGE AND MORTALITY IN IRRADIATED NONHIBERNATING MARMOTS

No.	Sex	Mean wt at r (g)	r	Mean wt at r + 18 days (g)	No. surviving	Mean survival time and range (days) of those dying
5	♂	2,388	550	2,361	3	21 (19–23)
4	♀	1,855	550	1,705	0	21 (18–27)
1	♂*	2,680	650	1,900	0	12

* This animal, included here for convenience, was maintained at 3.5° C and irradiated 71 days after entry into the cold.

The hibernator receiving 800 r died at 21 days while still in hibernation. During the second week there was a precipitous fall in body weight and in leucocyte and erythrocyte counts. During the hibernating phase the marmots given 650 r showed only those blood changes characteristic of hibernation, but after their return to room temperature both erythrocyte and leucocyte concentrations fell abruptly (*7*).

It is evident from the results of these experiments that a delay in the rate of development of the lethal processes following irradiation accompanies lowered body temperature and reduced metabolic rate in the marmot. The fact that irradiated marmots died in hibernation after only slightly higher doses (one 650 r, one 800 r) than that found lethal for most nonhibernators (550 r) indicates that no great decrease in sensitivity to radiation is attendant upon the change to the poikilothermic state.

References

1. Patt, H. M., and Swift, M. N. *Am. J. Physiol.*, **155**, 388 (1948).
2. Strangeways, T. S. P., and Fell, H. B. *Proc. Roy. Soc. (London)*, **B102**, 9 (1927).
3. Durtee, W. R. *J. Natl. Cancer Inst.*, **10**, 735 (1949).
4. Smith, W. W., *et al. Proc. Soc. Exptl. Biol. Med.*, **71**, 498 (1949).
5. Haley, T. J., Mann, S., and Dowdy, A. H. *Science*, **112**, 333 (1950).
6. Benedict, T. G., and Lee, R. C. *Carnegie Inst. Wash. Pub., No. 497* (1938).
7. Smith, F., and Grenan, M. (In preparation.)

The Hematologic Effect of Folinic Acid (Citrovorum Factor) in Persons with Pernicious Anemia[1]

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A factor in refined liver extract necessary for the growth of *Leuconostoc citrovorum* has been isolated by Sauberlich and Baumann (*1*). The growth-promoting properties of this factor cannot be replaced by vitamin B_{12} or thymidine, but growth of the organism will occur in the absence of this factor if very large amounts of folic acid are provided. Subsequently, Sauberlich (*2*) demonstrated that "citrovorum factor" overcomes the inhibitory effect of aminopterin on *Leuconostoc citrovorum*. The excretion of the "citrovorum factor" in the urine of rats or human beings is enhanced by the administration of folic acid (*3*). Nichols and Welch (*4*) have shown that "citrovorum-factor" activity of liver slices from normal and folic-acid–deficient rats is increased by incubation with folic acid, and that ascorbic acid enhances this effect. These data indicate that folic acid is a precursor of the "citrovorum factor" and suggest that ascorbic acid plays a part in the conversion.

Bond, Bardos, Sibley, and Shive (*5*) isolated a substance called "folinic acid" which overcomes the inhibition of methyl folic acid on the growth of *Lactobacillus casei* more effectively than folic acid. This substance is similar to the "citrovorum factor" in promoting the growth of *Leuconostoc citrovorum*. The same workers (*6*) have described a method for the synthesis of a substance with properties similar to "citrovorum factor" and "folinic acid," and it is probable that these two substances are identical.

May *et al.* (*7*) have reported that crystalline folinic acid is more effective than folic acid in relieving the megaloblastic anemia of monkeys deficient in folic and ascorbic acids. This observation, together with the work of Nichols and Welch mentioned above (*4*), suggests that folinic acid may be a biologically important intermediate in the metabolism of folic acid.

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[2] The authors wish to thank James M. Ruegsegger, of Lederle Laboratories, for generous supplies of crystalline citrovorum factor and folic acid.

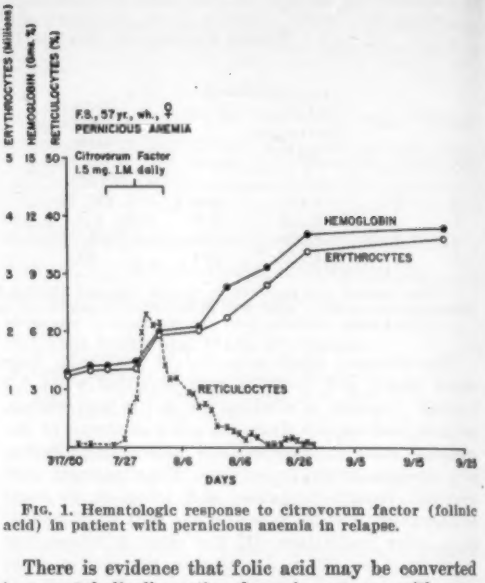

FIG. 1. Hematologic response to citrovorum factor (folinic acid) in patient with pernicious anemia in relapse.

There is evidence that folic acid may be converted to a metabolically active form in persons with pernicious anemia in relapse before it exerts its hematopoietic effect (*8–10*). Such a substance should induce a hematologic effect in doses much smaller than those usually required with folic acid. Since "folinic acid" has the potentiality of being this active form of folic acid, its hematopoietic effect has been tested in persons with pernicious anemia in relapse.

Three such subjects have received intramuscular injections of this substance for 10 consecutive days; the daily dose in 2 of the subjects was 3 mg and in the other, 1.5 mg. In all 3 patients hematologic responses occurred. Erythrocyte and hemoglobin rises were as good as would be expected with similar amounts of folic acid. Reticulocytes increased in all three instances, with peaks of 9%, 13.7%, and 23.1% on the sixth or seventh days of treatment. The megaloblastic bone marrow was converted rapidly to a normoblastic type, as happens after oral or parenteral treatment with folic acid. One of the hematologic responses is recorded in Fig. 1.

Folinic acid was no more effective than folic acid, however. One of the subjects who responded to the daily administration of 3 mg had previously failed to respond to 0.6 mg of the substance daily for 10 days. Another subject with pernicious anemia, previously responsive to refined liver extract, vitamin B_{12}, and folic acid, had relapsed hematologically while receiving 20 mg of folic acid daily. He was given 3 mg of "citrovorum factor" daily for 10 days. There was no reticulocytosis, and erythrocytes and hemoglobin failed to rise following this therapy. Subsequently, he was given vitamin B_{12}, 15 μg daily for 3 weeks and then 20 μg weekly. There was a desultory hematologic response similar to that previously described in similar subjects (*9*).

Direct instillation of "citrovorum factor" into the bone marrow cavity was performed in 3 persons with pernicious anemia in relapse; the amounts used were 0.06 mg, 1.5 mg, and 3 mg, respectively. In no instance was there evidence on Wright-Giemsa–stained marrow smears of the erythrocyte maturation effect that was observed locally after marrow instillation of vitamin B_{12} (*8*) but which did not occur after the instillation of 1 or 2 mg of folic acid into the marrow. In this respect, also, folinic acid is similar to folic acid.

This study demonstrates that "folinic acid" or "citrovorum factor" is a potent hematopoietic agent in pernicious anemia in relapse, but is no more effective than a similar dose of folic acid. The failure of the substance to produce a local erythrocyte maturation effect on instillation into the marrow cavity suggests that "citrovorum factor" or "folinic acid," like folic acid (*10*), must be altered elsewhere in the body before becoming active in hematopoiesis.

References

1. Sauberlich, H. E., and Baumann, C. A. *J. Biol. Chem.*, **176**, 165 (1948).
2. Sauberlich, H. E. *Arch. Biochem.*, **24**, 224 (1949).
3. ———. *J. Biol. Chem.*, **181**, 467 (1949).
4. Nichols, C. A., and Welch, A. D. *Proc. Soc. Exptl. Biol. Med.*, **74**, 52 (1950).
5. Bond, T. J., *et al. J. Am. Chem. Soc.*, **71**, 3852 (1949).
6. Shive, W., *et al. Ibid.*, **72**, 2817 (1950).
7. May, C. D., Sundberg, R. D., and Schaar, F. *Proc. Central Soc. for Clin. Research*, **23**, 71 (1950).
8. Mueller, J. F., Hawkins, V. R., and Vilter, R. W. *Blood*, **4**, 1117 (1949).
9. Vilter, R. W., *et al. Ibid.*, **5**, 695 (1950).
10. Horrigan, D. L., Jarrold, T., and Vilter, R. W. *J. Clin. Invest.*, **30**, 31 (1951).

Otitis Media and Audiogenic Seizures in Mice[1]

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Infection of the middle ear in rats has been shown to be a factor in the occurrence of audiogenic seizures (*1–3*). The original report by Patton (*2*) stressing the complications that might thus arise in using the incidence of seizures in rats as an index of nutritional deficiency has, however, been misinterpreted by some workers. They seem to believe that Patton proved that purulent otitis media is the only and sufficient cause of audiogenic seizures. Patton, however, stated that his observations "do not define the role of middle ear disease in the etiology of sound induced seizures," and that "the infection has not complicated the severe sound induced seizures associated with specific deficiencies, e.g., magnesium. . . ." Sound-induced seizures in rats are thus possible without concomitant otitis media (*1–3*). As Pilgrim and Patton (*3*) state, "The precise relationships between convulsions and the infection have not yet been elucidated."

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Laboratory mice exhibit audiogenic seizures similar to those of rats, and mice may be better than rats as test animals for certain purposes (*4*). Before mice are widely used for tests of auditory reactions, however, it seems advisable to determine the relationship, if any, between otitis media and seizures in these animals.

Mice of three strains were used in this study: dba Subline 1, C-57 black, Subline 6, and mongrel albino, so-called Swiss. The first two were obtained originally from the market stock of The Jackson Memorial Laboratory, Bar Harbor, Maine, the third from an animal dealer. All individuals used in our experiments were reared in our laboratory.

Seizures were induced by subjecting mice imprisoned in a small wire-mesh cage to a sound field at 10 kc frequency and 110 db average sound pressure. The animals were tested daily from 15 to 50 days of age. Mice of all three strains are susceptible during some part of this period. Details of the apparatus and procedures have been published elsewhere (*5*). The occurrence of otitis media was determined by autopsy carried out under a binocular dissecting microscope. The bulla and tympanum were exposed and penetrated, and the middle ear was carefully examined for inflammation and pus.

The mice autopsied were of the following classes: (1) animals which either had no seizures during the test period or had seizures during the early part of the period (20–30 days of age) but stopped having seizures at least 10 days before the examination; and (2) animals which died as a result of clonic-tonic seizures. The second group certainly includes the most susceptible mice in the colony. In the first group (controls) were 70 albinos, 10 dba's, and 10 C-57's; in the second group were 131 albinos, 53 dba's, and 16 C-57's. Approximately half the mice in each group were males and half females, and they varied in age from 18 to 50 days, most of the animals that died being 20–30 days old.

No case of otitis media was found in the control group, and only one case of the disease was found in animals dying in seizure, a unilateral infection in a dba. One other case appeared during the study. An albino which had only 2 seizures, at 20 and 21 days of age, developed, at 41 days of age, definite symptoms of middle ear infection and labyrinthitis, holding the head to the side and swinging in a circle when held by the tail. Dissection of the middle ear, when the mouse was 42 days old, confirmed the diagnosis. Since this animal had a low seizure record, it seemed advisable to examine animals with similar records but without clinical symptoms of the disease. Twenty albino mice with similar records were examined, and no case of otitis media was found.

It is obvious that the incidence of otitis media in our colony of laboratory mice is very low. This accords well with the report of Caussé (*6*) that otitis media is found in at most 1% of white mice. The low incidence found here is matched by that discovered quite independently for dba's and C-57's by Miller and

Zamis (*7*). These results contrast strikingly with reports by the workers with rats (*1, 2*) that 80–95% of their animals were infected.

So far as mice are concerned, therefore, otitis media is not necessary for susceptibility to audiogenic seizures. Further, the very low incidence of the disease in mouse colonies makes it negligible as a complication in studies on auditory reactions.

References

1. KENSHALO, D. R., and KRYTER, K. D. *J. Comp. Physiol. Psychol.*, **42**, 328 (1949).
2. PATTON, R. A. *J. Psychol.*, **24**, 313 (1947).
3. PILGRIM, F. J., and PATTON, R. A. *J. Comp. Physiol. Psychol.*, **42**, 422 (1949).
4. SCOTT, J. P. *Science*, **111**, 583 (1950).
5. FRINGS, H., FRINGS, M., and KIVERT, A. *J. Mammal.*, **32**, 60 (1951).
6. CAUSSE, R. *Compt. rend. soc. biol.*, **136**, 726 (1942).
7. MILLER, D. S., and ZAMIS, M. J. *Anat. Record*, **105**, 556 (1949).

Immunochemical Changes in Chicken Serum During Development of Rous Sarcoma[1]

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It is well known (*1–9*) that during the growth and maturation of the individual changes occur in the serum, manifested by an increase in globulin and by the appearance of various antibodies for cells of foreign species and multiple infectious agents. In the chicken one finds antibodies against tumor viruses, e.g., the Rous sarcoma (*3*), and also, as recently found in this laboratory, against *Proteus*, a bacterium that thrives in autolyzed extracts of this same sarcoma.

Furthermore, it is recognized (*1*) that, as a common denominator to the development of natural or experimentally induced antibodies in chickens, a factor appears in the globulin fraction of the serum which is endowed with the property of flocculating, in the cold, saline or alcoholic extracts of many tissues from many species of animals.

On the other hand, it has been found by several workers (*4–6*) that chickens bearing the Rous sarcoma or a lymphocytoma show a hypoproteinemia depending not on changes in the plasma volume (*6*) but rather, in the case of the lymphocytoma, on a reduction of albumin and occasionally of globulin.

In our studies on the immunochemical changes in the serum during malignancy, we focused our attention on the naturally present antibodies as well as on the factor flocculating tissue extracts, and it was soon apparent that in chickens bearing the Rous sarcoma there was a diminution in some of these immune

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[2] National Cancer Institute special research fellow.

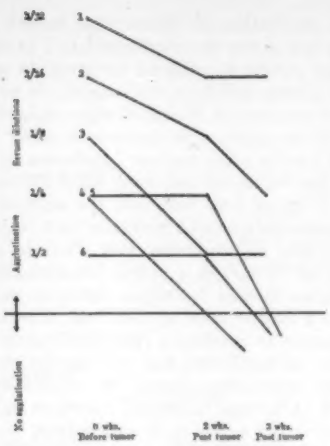

FIG. 1. Decline of *Proteus agglutinin* in chicken serum during development of Rous sarcoma.

bodies. Although this decrease was quite evident with the globulin factor flocculating tissue extracts in our test (mouse liver), it was most clear-cut in an agglutination reaction with *Proteus*. We paralleled these studies with an analysis of serum protein and have compared the results of both methods in the following note.[3]

Proteus agglutinin can be readily detected by combining serum with a live culture, vaccine, or O antigen of the *Proteus vulgaris* or *OX19* strains, both of which are equally suitable.[4] The organisms were grown in broth for 24 hr and then transplanted to agar for the same length of time. The agar growth was suspended in physiological saline, to which we added 30% by volume of alcohol and incubated the mixture overnight at 37° C. At this stage the bacilli were usually dead and could be centrifuged to obtain a precipitate which was resuspended in 7 equal volumes of saline. Before testing, this initial stock solution was further diluted 10–15 times with saline, depending upon trial tests necessary to determine the greatest dilution that would give agglutination with normal central sera. The actual test was done in small test tubes (1.2 cm × 10.1 cm) protected with cork stoppers. To each tube containing 0.1 ml of serum, inactivated or not, undiluted or in dilution, we added 0.1 ml of antigen and, after incubating at room temperature, read the tubes with the aid of a binocular microscope (10× and 23×) at several time intervals over a 2-hr period. Similarly, the presence of the tissue flocculating factor in chicken serum was indicated by flocculation with a 5% saline extract of mouse liver kept at 0° C for 24 hr.

Both determinations indicated a high incidence of

[3] While this paper was in press, the Lankenau Hospital reported similar results with mice (*12*).

[4] The strains were obtained from the American Type Culture Collection. In the earliest stages of our work, however, we used *Proteus* which was isolated and identified through the kindness of Leanor Haley, from a contaminated extract of chicken sarcoma.

these immune bodies in normal adult chickens which develop some time after one month of age and which diminish so rapidly in the wake of a Rous sarcoma that, in many cases, they could scarcely be detected at the end of 2–3 weeks. On every sample of serum taken before and after tumor growth, titrations were done simultaneously with the same antigen preparation. Although the titers of *Proteus agglutinin* were rather low, a significant decline was constantly observed in the several dozen birds followed, and we have selected 6 representative sera for the accompanying chart (Fig. 1). In these experiments with rapidly growing tumor the chickens were dead 4–5 weeks after tumor transplant. In all, we used more than 60 birds, some White Leghorn, but chiefly Plymouth Rock.

Concurrent with our investigation of antibody titer, we determined serum proteins by the biuret method of Gornall *et al.* (*10*), spot-checking the results against Kjeldahl analysis. Our fractionations were done with either the ammonium sulfate or sodium sulfate (*11*) procedure. All these determinations indicated that serum protein undergoes considerable change in the development of a normal chicken. Young chicks have less protein per ml of serum when compared to the increase in adult fowl where the augmented globulin fraction is mainly responsible. This difference can be expressed by the albumin globulin ratio, which is greater than 1.0 in young chicks and completely reversed in adult birds. In fact, our fractionation with sodium sulfate gave an A/G ratio of 0.35 for normal adult chickens, which closely approximates the 0.37 determined by electrophoretic studies (*6*). This value may then be compared to the 0.86 ratio of one-month-old chicks and the 1.08 ratio we determined in 10-day-old chicks (Table 1).

In adult chickens with a rapidly growing Rous sarcoma we found a hypoproteinemia of varying degree, some showing only a very slight drop in total protein. Fractionation of the sera of these birds revealed a moderate reduction in albumin, whereas the globulin, more specifically euglobulin fraction, changed significantly. On the average, the total protein reduction in tumor-bearing birds was about 22%, whereas the average reduction of albumin was only 14%. A hypoglobulinemia resulted from an average drop in total globulin equal to 22%, being as much as 40% in some cases. Furthermore, we found a reduction in the euglobulin fraction even in cases where there was an insignificant fall in the total serum protein. This is of particular interest, since we were able to locate the *Proteus* antibody and the liver extract flocculating factor in the euglobulin fraction and have recovered them almost quantitatively by fractionation with ammonium sulfate (21.6% $(NH_4)_2SO_4$ on dry weight basis). Although our titration of the immune bodies in different concentrations of protein (i.e., euglobulin) reveals that they decrease in chickens with massive tumor faster than does the diminishing euglobulin, nevertheless this reduction of euglobulin in birds with fast-growing Rous sarcoma is comparable to the diminished γ-globulin of late human cancer (*14*).

TABLE 1

SERUM PROTEIN IN CHICKENS OF DIFFERENT AGES (mg/ml)

Determination	Adult—average value and deviation	Combined bleedings (1 month)	Combined bleedings (10 days)
Total protein*	55.7 ± 6.3	37.3	34.9
Euglobulin	29.8 ± 5.5	—	—
Pseudoglobulin	10.7 ± 2.1	—	—
Total globulin	42.2 ± 5.8	20.0	16.8
Albumin	14.1 ± 3.1	17.3	18.1
A/G	0.35 ± 0.2	0.86	1.08

* Our values for total protein correspond to the analysis of Herman (*13*).

It should be noted that similar investigations made on normal birds, cohabitating with the diseased chickens and bled at the same intervals, indicated no comparable change. These normal chickens evidenced a small gain in weight, whereas the tumor-bearing birds failed to gain or even showed a slight loss. We consider these variations insignificant, however, in comparison to the described changes in the pattern of serum protein.

Thus with chickens bearing a rapidly developing Rous sarcoma, we note a decline in serum globulin (i.e., euglobulin) which is manifested by the suppression of natural immune bodies as indicated by the reduction of *Proteus agglutinin* and the flocculating factor from tissue extracts. Since this fall in antibody titer preceded any diminution of the globulin fraction, it appears to be an indication of a qualitative change in globulin, and it seems to us that such a method of nonspecific antibody titration could afford a sensitive index of early change in serum globulin.

Phenomena in many ways comparable to those described have been found in human sera and have been reported in another article (*15*). Furthermore, experiments concerned with the effect of chemical carcinogens on the serum globulin are also under way.

References

1. DURAN-REYNALS, F. *Yale J. Biol. and Med.*, **12**, 361 (1940).
2. BAUMGARTNER, L. Thesis, Yale University (1932).
3. DURAN-REYNALS, F. *Yale J. Biol. and Med.*, **13**, 61 (1940).
4. MALTANER, F. *Ann. Rept. Div. Lab. Research, N. Y. State Dept. Health*, 24 (1947).
5. CASELLI, P. *Med. sper.-arch. ital.*, **8**, 417 (1941).
6. KREJCI, L. E., ROSS, M. H., and SWEENEY, L. *Cancer Research*, **8**, 575 (1948).
7. DEUTSCH, H. F., NICHOL, J. C., and COHN, M. *J. Immunol.*, **63**, 195 (1949).
8. OLESON, J. J. *Trans. N. Y. Acad. Sci.*, **12**, 118 (1950).
9. LITTLE, P. A., OLESON, J. J., and ROESCH, P. K. *Bact. Proc.*, 73 (1950).
10. GORNALL, A. G., BARDAWILL, C. J., and DAVID, M. M. *J. Biol. Chem.*, **177**, 751 (1949).
11. MAJOOR, C. L. H. *Yale J. Biol. and Med.*, **18**, 419 (1945–46).
12. WHARTON, D. R. A., *et al. Cancer Research*, **11**, 127 (1951).
13. HERMAN, G. R. *Proc. Soc. Exptl. Biol. Med.*, **61**, 229 (1946).
14. MIDDER, G. B., ALLING, E. L., and MORTON, *J. Cancer*, **3**, 56 (1950).
15. PARFENTJEV, I. A., CLIFFTON, E. E., and DURAN-REYNALS, F. *Science*, **113**, 523 (1951).

Survey of Factors Responsible for Reduction of 2,3,5-Triphenyltetrazolium Chloride in Plant Meristems

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Several workers have reported in this journal that dehydrogenase enzyme systems may be responsible for the reduction of 2,3,5-triphenyltetrazolium chloride. Mattson, Jensen, and Dutcher (*1*) suggested that the reduction of tetrazolium is caused by dehydrogenase systems requiring coenzymes I or II. It is possible for this compound to act as an electron acceptor for many pyridine nucleotide dehydrogenases. It was found that one of these holoenzymes, glucose dehydrogenase–coenzyme I, in the presence of its substrate, reduces the salt at pH 6.6 (*1*). It was found that tissues heated to 82° C or higher lose their ability to reduce tetrazolium (*1, 2*). Kun and Abood (*3*) found that tetrazolium is an indicator of succinic dehydrogenase activity of tissue homogenates. Fred and Knight (*4*) reported a lack of specificity for inhibitors. These workers also found that aeration by shaking retarded reduction, possibly because it raised the redox potential over −0.08 v, or because oxygen competed with the indicator. Kretovich (*5*) observed that there is a close correlation between loss of dehydrogenase activity of embryos and loss of viability, and that the dehydrogenase system of wheat embryos is activated by hexose di- and monophosphate, among other hydrogen donors. Other workers have reported that the sites of reduction of tetrazolium were also sites of reactions for phosphate ion (*6*).

In conjunction with a survey of tissues that reduce 2,3,5-triphenyltetrazolium chloride (*7*), the writer conducted experiments to determine the factors and substances responsible for the reduction of the indicator in normal plant tissues. The present study describes the results of the application of a series of enzymatic or metabolic inhibitors on the reduction of the tetrazolium salt to the red insoluble formazan in plant meristems. The effect of buffering these inhibitors was also investigated. Studies were made with 1-(4-chloromercuriphenylazo)-naphthol-2, which has a high specificity for sulfhydryl groups. Comparisons were made between the staining pattern obtained with this reagent and with tetrazolium.

A series of inhibitors (1% aqueous solutions) were used in a study of reactions in embryos of *Zea mays*. *Zea mays* seeds were split longitudinally, and a thin tangential section was cut from one of the exposed surfaces of the embryo. The sections were then placed in a spot plate and the test inhibitor added for 5 min. The sections were washed with water and placed in a 1% aqueous solution of tetrazolium. Readings were taken on the tissue samples after periods varying from a few minutes to several hours. The method of application of the buffer solutions (McIlvaine's standard) was similar to that of the inhibitors. The buffers were added to the tissue samples and allowed to stand for 5 min. The buffers were removed, and a 1% solution of tetrazolium was added to the test materials. The pH determinations were made with a Beckman pH meter.

The inhibition studies revealed four categories of inhibition (strong, medium, weak, and no inhibition). The strong inhibitors were benzaldehyde, ethyl alcohol (80%), iodoacetic acid, pyruvic acid, salicylaldehyde, and thioglycollic acid. The medium inhibitors were 2,6-dinitrophenol, ethyl alcohol (60%), hydroxylamine hydrochloride, and succinic acid. The weak inhibitors were benzidine dihydrochloride, chloroform, ethyl alcohol (40%), phenyl mercuric chloride, and thiourea. Those showing no appreciable effect on the reduction were coumarin, 2,4-dichlorophenoxyacetic acid, ethyl alcohol (20%), ethyl carbamate, potassium cyanide, sodium arsenite, sodium azide, sodium fluoride, and sodium pyrophosphate. Ethyl alcohol inhibited reduction proportionally to the concentration of the alcohol. The aldehydes probably prevented reduction by forming a mechanical barrier to the entrance of tetrazolium. Pyridine is a weak base and may possibly be an enzymatic inhibitor. Although 2,4-dichlorophenoxyacetic acid, in certain concentrations, has an inhibitory effect on respiratory functions, it has no effect in inhibiting the reduction. The reduction was strongly inhibited by 2,6-dinitrophenol, which has been reported to remove the coupling between respiration and phosphorylation. Coumarin, an inhibitor of sulfhydryl groups, had no apparent effect on the reduction. Sodium pyrophosphate, a specific inhibitor for succinic dehydrogenase, had no effect on the reduction. Several of the strong inhibitors are acids, and the pH values are far below the minimum value for normal reduction to take place. The approximate optimum value for the tetrazolium reduction in normal tissues is from pH 6.5 to 7.5. It was found that viable embryos stained intensely from 8.0 to 6.6. From the latter value to 6.0 the staining became progressively paler in color, and little reduction was evident at pH 5.0. On buffering the acid inhibitors at neutrality, reduction was observed in most cases. Acid inhibition probably results from an increased hydrogen ion concentration and not from a selective inhibition of some cellular component.

Bennett (*8*) synthesized a sulfhydryl reagent, 1-(4-chloromercuriphenylazo)-naphthol-2, in the hope that it would retain the high specificity for sulfhydryl possessed by phenyl mercuric chloride, and that the sites at which it combines with sulfhydryl protein in the tissue might be visualized directly under the microscope. The sulfhydryl reagent was used in a study of the sulfhydryl protein pattern in *Zea mays* embryos. A solution of the reagent in toluene was added dropwise to embryo slices that previously had been killed and dehydrated in an alcohol series. Within an hour the vascular traces of the embryo slices were stained, and 24 hr later the embryo slices were stained throughout. The sulfhydryl pattern obtained was identical

with that of the tetrazolium pattern of *Zea mays* embryo slices. Attempts were made to inhibit the sulfhydryl reaction with the tetrazolium reduction inhibitors. It was found that several of the tetrazolium reduction inhibitors also blocked the sulfhydryl groups. Embryo slices treated with thioglycollic acid gave no sulfhydryl pattern, iodoacetic acid resulted in a weak reaction, and 2,4-dinitrophenol in a medium reaction.

It appears highly probable that dehydrogenase enzyme systems are responsible for the oxidation of various substrates and the concomitant reduction of tetrazolium to formazan. The reducing agent is heat-labile, but remains undamaged by freezing. It has also been observed by the author that homogenized tissues give a much weaker reaction. The classic experiments of Thunberg demonstrated that dehydrogenases are responsible for reduction of reversible redox dyes. However, because of the lack of specificity for the reaction, as shown by inhibition studies, it is probable that no one reductase system is responsible for the characteristic reduction in plant tissues. It seems more likely that a general redox potential level, maintained by the operation of several physiologically active systems, brings about the reduction of tetrazolium.

References

1. MATTSON, A. M., JENSEN, C. O., and DUTCHER, R. A. *Science* **106**, 294 (1947).
2. WAUGH, T. C. *Ibid.*, **107**, 275 (1948).
3. KUN, E., and ABOOD, L. G. *Ibid.*, **109**, 144 (1949).
4. FRED, R. B., and KNIGHT, S. G. *Ibid.*, 169.
5. KRETOVICH, V. L. *Akad. Nauk. S. S. S. R., Inst. Biokhim., Moscow-Leningrad*, 136 pp. Comprehensive abs. in *Chem. Abs.*, **40**, 1237 (1946).
6. DUFRENOY, J., and PRATT, R. *Am. J. Botany*, **35**, 333 (1948).
7. ROBERTS, L. W. *Bull. Torrey Botan. Club*, **77**, 372 (1950).
8. BENNETT, H. S. *J. Am. Chem. Soc.*, **70**, 3522 (1948).

The Relationship of Acoustical Energy to the Lethal Effects of Ultrasonic Vibrations on *E. coli*[1]

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In a previous paper (*1*) it was shown that the rate of destruction of *E. coli* by ultrasonic vibrations at 400 kc was influenced significantly by the environmental temperature. Many other factors undoubtedly influence the germicidal properties of these vibrations, one of which should be the energy input to the sample under treatment. Accordingly, it was desirable to investigate this factor and to determine its significance.

Using the apparatus previously described (*1*), a series of tests was conducted wherein the energy input to a sample containing an aqueous suspension of *E. coli* was varied by controlling the variable transformer in the electronic driving circuit.

[1] Conducted under Grant RG-2093(C) from the National Institutes of Health, USPHS.

TABLE 1

PERCENTAGE OF *E. coli* SURVIVING ULTRASONIC VIBRATIONS AFTER VARIOUS EXPOSURE TIMES AND AT VARIOUS ENERGY INTENSITIES AT 15.5° C

Exposure duration (min)	Energy intensity, acoustical w/cm²								
	4.8	5.8	7.2	9.1	11.5	14.4	18.6	24.0	31.3
3	97.5	100.1	88.6	83.3	88.6	74.7	71.5	73.6	76.9
6	85.4	85.0	75.7	73.3	71.8	56.4	52.8	58.1	59.4
15	65.1	66.5	54.5	50.5	40.2	22.4	15.9	17.9	26.4
25	53.2	46.1	35.3	36.3	21.5	13.2	10.5	7.1	9.9
40	39.1	34.1	20.9	15.9	9.24	5.04	3.41	1.77	2.69
60	21.0	18.0	9.87	4.11	0.10	0.42	0.08	0.34	0.62

In order to determine the amount of acoustical energy that reached the sample, a Siemens power meter was suspended in the oil bath at the same position with regard to the crystal that the sample normally occupied. Varying amounts of acoustical energy were beamed to the meter by changing the setting of the variable transformer in the driving circuit. The readings of the power meter were correlated with readings obtained simultaneously from a voltmeter inserted in the electronic circuit across the crystal. In this manner the voltmeter was calibrated to read in terms of the acoustical energy applied to the sample. Since the power meter used did not cover the entire range of energy intensities available from the generator, it was necessary to extrapolate the calibration curve for high intensity energy inputs.

Altogether, sixty-seven 1-hr runs were made on *E. coli* suspended in buffered water. The suspension was prepared by introducing 1 ml of a 24-hr broth culture of *E. coli* into 100 ml of sterile buffered water. The environmental temperature for all the observations was maintained at 15.5° C. The initial concentration of viable cells in all cases was approximately 80,000/ml. Statistical analyses of the results obtained were made and are presented herewith (Table 1 and Fig. 1).

It is apparent from Fig. 1 that the killing curve is essentially logarithmic at all energy intensities. In some cases, toward the end of the run, the curves tend to level out somewhat, but generally speaking the straight-line relationship applies. In those cases where the rate of killing showed a slight curvature, the initial killing rate, obtained during the first 30 min, was chosen as the characteristic rate for that particular energy intensity. It may also be concluded from Fig. 1 that, although an increase in energy intensity (within limits) results in an increase in the killing rate, an intensity is finally reached which yields the maximum killing rate; and that further increases in energy intensity result merely in reduced lethal effects. This is clearly shown in Table 2 and Fig. 2.

Fig. 2 was obtained by plotting the killing rate constant, as determined by the slope of the killing curve,

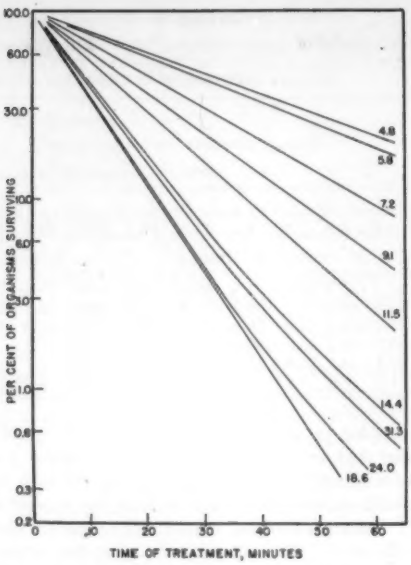

FIG. 1. Relation of energy intensity to the survival by *E. coli* of ultrasonic vibrations. Intensities are in acoustical w/cm².

against the energy necessary to obtain that rate. The curve shown in Fig. 2 is similar to that obtained by Weissler (*2*) in his investigations on the relationship of acoustical energy intensity to the liberation of iodine from potassium iodide solutions. The ordinate in Fig. 2 is the slope-dependent form of the rate constant *M*, from the equation of the killing curve

$$Y = 10^{(2-\frac{X}{M})},$$

where *Y* is the percentage of *E. coli* surviving ultrasonic treatment at any time *X*. In all cases the slope used to determine the factor *M* was the initial slope of the killing curve.

Fig. 2 indicates that the killing effect of ultrasonic vibrations is decreased after a certain peak, or optimum, energy intensity is reached, despite further apparent increases in the energy intensity. This is probably due to the fact that at higher energy intensities the sound wave is attenuated because of the presence of excessive cavitation bubbles in its path. The cavitation bubbles, which are filled with the gases dissolved in the liquid medium, are formed in large numbers during the low pressure phase of the higher intensity sound waves. Thus they effectively prevent the uninterrupted passage of the sound wave. In consequence, only a small portion of the sample receives a continuous application of sound energy, and the net effect is to decrease the killing rate.

This attenuation of the sound wave may also be observed qualitatively by considering the typical radiation fountain formed in the water at the top of the sample container as the output of the generating unit is increased. The radiation fountain increases in size until it is approximately an inch above the normal water surface. As the energy output increases, there is a sudden cutoff of the fountain, the water surface is only gently agitated, and a buzzing sound is heard.

TABLE 2

KILLING RATE AS CHARACTERIZED BY CONSTANT, *M*, IN EQUATION $Y = 10^{(2-\frac{X}{M})}$*

Energy intensity w/cm²	Rate constant, *M*
4.8	92.3
5.8	82.9
7.2	58.3
9.1	46.4
11.5	37.7
14.4	26.3
18.6	21.8
24.0	22.8
31.3	25.3

* *Y* = percentage of *E. coli* surviving at given time *X*; *M* = initial slope of killing curve.

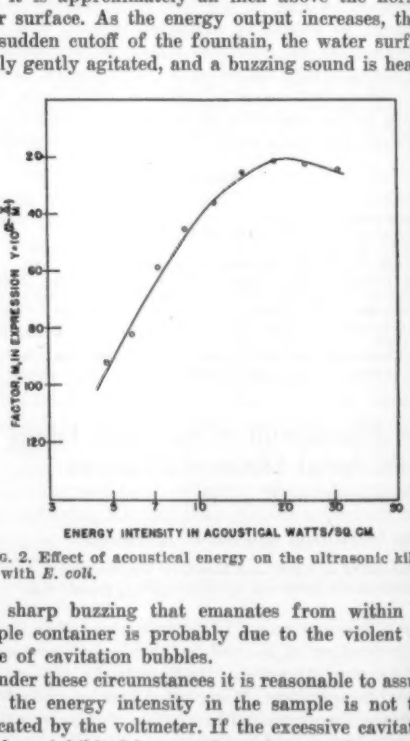

FIG. 2. Effect of acoustical energy on the ultrasonic killing rate with *E. coli*.

The sharp buzzing that emanates from within the sample container is probably due to the violent collapse of cavitation bubbles.

Under these circumstances it is reasonable to assume that the energy intensity in the sample is not that indicated by the voltmeter. If the excessive cavitation had been inhibited by superimposing an adequate additional pressure on the surface of the sample, it is apparent that the energy intensity necessary to induce an amount of cavitation sufficient to attenuate the sound wave would have been higher than that shown in Fig. 2, where cavitation was not inhibited. The important fact is that, because cavitation attenuates the sound wave at high energy intensities, there is a definite upper limit to the effective energy in-

tensity that may be introduced into a sample with a flat crystal, unless cavitation is inhibited by excess pressure at the surface or by degasifying the sample. However, since many of the effects of ultrasonic vibrations are directly attributable to cavitation, its inhibition or prevention would defeat the purpose of applying acoustical energy to a sample.

References

1. HORWOOD, M. P., HORTON, J. P., and MINCH, V. A. *J. Am. Water Works Assoc.*, **43**, 153 (1951).
2. WEISSLER, A. Physico-Chemical Effects of Ultrasonics. Paper presented before Am. Inst. Chem. Eng., Swampscott, Mass. (May 30, 1950).

Biosynthesis of Radioactive Asparagine from $C^{14}O_2$[1]

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As a first step toward the elucidation of the metabolism of asparagine and other nitrogen compounds, the following method of preparing radioactive asparagine has been developed. Since leguminous seedlings synthesize exceptionally large amounts of asparagine, it was decided to try blue lupin, *Lupinus angustifolius*, as experimental material. Preliminary work (*1*) has indicated that in this plant the peak in asparagine content is reached on the twelfth day after germination. This suggested the use of seedlings prior to this date.

It was reported by several workers (*2*) that plants supplied with glucose synthesize more asparagine than those which are not. Assuming that the asparagine carbon chain is produced directly from sugar, this observation suggests two different methods for the synthesis of radioactive asparagine. In both cases plants should be placed under the conditions favoring accumulation of asparagine, and either infiltrated with radioactive glucose or permitted to carry on photosynthesis in the presence of $C^{14}O_2$. The second method was adopted, and preliminary tests have indicated that in 8-day-old lupin seedlings the photosynthetic mechanism has already been developed.

In our earlier experiments about 50 g of seeds were soaked for 4 hr in distilled water and sown in vermiculite in small plastic dishes. Seedlings were grown at 25° C on a 15-hr day in a constant temperature and light chamber. When they were 8–9 days old, the plastic dish with the seedlings was placed in an 8-l desiccator, and this was filled with air containing 5% CO_2 and about 0.25 mC of $C_{14}O_2$. After 24 hr of continuous illumination with fluorescent bulbs at a light intensity of 400 ft-c, the desiccator was aerated to remove the residual CO_2. From 97–99% of the CO_2 present initially was absorbed by the seedlings. The plants were then frozen at −40° C, thawed out, and minced in a Waring Blendor. The brei was suspended in about 600 ml of distilled water, brought to 90° C, and held there for 5 min. After cooling to room temperature it was acidified with glacial acetic acid to pH 4 and left standing at 4° C for 12 hr. At the end of this time the precipitate formed was filtered off, the filtrate was decolorized with charcoal and concentrated to about 5 ml. Radioactive asparagine crystallized out on cooling without the addition of carrier. As is seen from Table 1, the activity of the asparagine obtained in these first four experiments was quite low.

TABLE 1

ACTIVITY OF THE ASPARAGINE ISOLATED

Experiment No.	Material	Duration of experiment (days)	Isolated asparagine (g)	Activity in asparagine (μc/mM)	Mc given	Percentage mc recovered
1	Blue lupin seedlings*	1	——	0.688	0.25	—
2	Blue lupin seedlings*	1	——	0.238	.25	—
3	Blue lupin seedlings*	1	——	0.279	.25	—
4	Blue lupin seedlings*	1	——	0.301	.25	—
5	Tobacco leaves†	11	——	3.72	.25	—
6	Tobacco leaves†	6	0.176	4.74	.25	2.5
7	White lupin seedlings*	3	2.724	0.73	.5	3.6
8	Blue lupin seedlings*	6	0.620	2.00	0.25	3.0
9	Blue lupin seedlings*	6	1.789	1.47	1.00	2.0

* Asparagine crystallized out without carrier.
† Asparagine crystallized out only after the addition of about 0.5 g of the carrier.

It was observed earlier (*3*) that when tobacco leaves were permitted to carry on photosynthesis for 24 hr under approximately the same conditions, they produced glucose with the activity of about 338 μc/mM, or about 1,000 times stronger than the asparagine. Assuming that the sugars in lupin seedlings had a comparable activity, the low activity of the asparagine obtained might be due to two causes. Either the immediate precursor of the asparagine carbon chain is not a sugar, but is, for example, a protein, or the amounts of radioactive asparagine produced were greatly diluted by ordinary asparagine present in the seedlings. On the basis of either explanation, it appeared desirable to extend the time of contact with $C^{14}O_2$.

Fifteen young tobacco leaves were detached and placed on 0.1% NH_4Cl in an 8-l desiccator in an atmosphere of 5% CO_2 with 0.25 mc of $C^{14}O_2$. The desiccator was placed between two 200-w incandescent bulbs, with light being filtered through about 8 cm of

[1] This work was aided by a grant from the National Research Council of Canada.

[2] Holder of a Research Council of Ontario scholarship.

water held in two museum jars. The leaves were illuminated 15 hr/day. After 11 days they were frozen and their asparagine was extracted as from the lupin seedlings described above. A duplicate experiment was run for 6 days. As indicated in Table 1, the asparagine from tobacco leaves had a much greater activity.

Longer periods of illumination were then tried with lupin seedlings. One hundred g of white lupin seeds were soaked, planted in flats in sand, and grown in a greenhouse. Eight-day-old seedlings were cut off at the ground level, and put in a desiccator with their stems immersed in 0.1% NH_4Cl. They were illuminated for 3 days, and their asparagine extracted. This experiment was repeated twice, using blue lupin seedlings illuminated for 6 days (Table 1).

It is apparent from Table 1 that by extending the time of contact with $C^{14}O_2$ the activity of the asparagine is considerably increased. It might be possible to increase it still further by raising the amounts of C^{14} in the air during the experiment. Since lupin seedlings could be utilized for such a synthesis within 8 days after germination, and since they yield larger amounts of radioactive asparagine than tobacco leaves, their use appears preferable.

References

1. WILSON, D. G. *The Biosynthesis of Radioactive Asparagine from $C^{14}O_2$.* M.A. thesis, Queen's University (1950).
2. CHIBNALL, A. C. *Protein Metabolism in Plants.* New Haven, Conn.: Yale Univ. Press (1939).
3. VITTORIO, P., KROTKOV, G., and REED, G. B. *Proc. Soc. Exptl. Biol. Med.*, **74**, 775 (1950).

Comments and Communications

The Search for Truth

The New York State law referred to in your March 2 issue does not—as your headline claims—represent "A Return to Medievalism in Science Teaching." Rather, it gives the individual citizen protection against the growing tendency toward statism, with its enslavement of body and mind to the whims of the relatively few men whose aim is to force conformity to their own political, economic, or scientific views—however sincerely they may believe them to be in "the interests of society."

Who is to say what constitutes the "truth" claimed for "scientific laws . . . established beyond a doubt"? In every age there have been men who claimed privileged knowledge of "scientific truth" when, in very fact, their so-called knowledge was but the exposition of theories originated in their own minds to explain, to their greater satisfaction, certain physical or mental phenomena that were not wholly explained by previous beliefs. There is today no avenue of scientific investigation in which the intellectually honest scientist will assert that the theories on which current investigations are conducted have been "established beyond doubt." The most any such scientist will claim is that the currently accepted theories provide a more satisfactory working basis than was afforded by yesterday's theories. And the sincere scientist expects tomorrow to reveal new theories that will supersede those of today and bring man one step nearer a knowledge of incontrovertible truth.

In the light of scientific history, who can say that we have, today, an absolute knowledge of truth—and that the citizen who chooses, for religious or any other reasons, to question the desirability of accepting today's theories should be forced to relinquish his own sincerely held beliefs in favor of theories he has ample reason to believe will, tomorrow, be outmoded?

The very vehemence of the argument that the individual's exercise of his right to religious freedom may bring "a time when our scientific curricula will be demolished piecemeal" proves the weakness of this argument. As long as thinking men press their search for the ultimate truth, *theories* will be superseded, but our scientific curricula will become ever stronger and more valuable.

Any attempt to abrogate the right of the individual citizen to refuse acceptance of a scientific theory—whether it apply to biology, physics, geography, or whatever—is an expression of bigotry. And bigotry of any nature—scientific or religious—is intolerable to free men.

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Editorial Note: The following Introduction from a *Brief Urging the Repeal of Subdivision 5 of the (N. Y.) State Education Law, Section 3204, Chapter 135, August 1, 1950,* was prepared by The New York Association of Teachers of the Biological Sciences and The New York Association of Chairmen of the Biological Sciences. It summarizes the issues involved in the controversy, as viewed by science teachers.

The teaching of health and the establishment of health habits have been one of the cardinal objectives of education for many years. In 1942, the New York State Regents passed a regulation requiring the teaching of health in the high schools of the state. Bulletin 1371, *The Health Teaching Syllabus for the Junior and Senior High Schools,* was "designed to present the material for the basic course work in health required by the Regents."

In 1950, the New York State Legislature passed a law which adversely affects the teaching of health in the schools of the state. Under this law, "subject to rules and regulations of the Board of Regents, a pupil may be excused from such study of health and hygiene as conflicts with the religion of his parents or

guardian." The amendment was specifically sought by the Christian Science Church.

Dr. Lewis A. Wilson, Commissioner of Education, has already approved the exemption of the children of parents or guardians of the Christian Science faith from instruction in the units of disease prevention and control and has indicated specifically which parts of the syllabus are to be omitted in their case. According to his ruling, these children will get no instruction in such areas as the building up of resistance to disease; the understanding of current health programs, both public and private; measures used to prevent the spread of communicable diseases; the importance of heart disease, cancer, diabetes, diphtheria, typhoid fever, tuberculosis, and infantile paralysis; the role of insects in the transmission of disease, a role which properly understood enabled the United States to build the Panama Canal after France had failed; the relation of the sanitary control of water and food to public health; war conditions and the problem of disease control and prevention; what bacteria are; the work of such eminent figures as Florence Nightingale, Louis Pasteur, Walter Reed, Robert Koch, and Alexander Fleming, the discoverer of penicillin; the home care of the sick; first-aid treatment; and so on. This is only a sampling of the units of instruction that fall under the ban of law.

It is obvious from the mere listing of these topics that the law will deprive exempted children of invaluable information; but even more, the Commissioner goes on to state that "required sections of the Regents examination as well as the State Scholarship examinations will be constructed so as not to penalize pupils who have been excused from instruction in the specified units of study." Thus, de-emphasis and virtual elimination of these topics loom up for all children, Christian Science or not. Even on a history examination, for example, no question may be asked about Louis Pasteur or Gen. William Gorgas, for these men were concerned with disease control.

This law and its method of implementation are so alarming from the point of view of the protection of the health of the individual and the community and from the point of view of the preservation of the state itself and its public educational system, that a widespread demand for its repeal is in order.

Lipoid-Lipoprotein Cholesterol

THE ultracentrifuge studies of J. W. Gofman and co-workers on lipoid-lipoprotein cholesterol complexes in sera have established the importance of the differences in the physical state, especially particle size, in atherosclerosis. We have observed an even more striking similar effect while producing experimental hypercholesteremia in rabbits. In these animals a definite and consistent layering of the hyperlipemic and cholesteremic sera occurs merely on standing. Two definite layers form without centrifuging, similar to cream in a bottle of milk. This process is accentuated and quickened by an ordinary centrifuge. The upper layer consists of large aggregates which may be seen easily with an ordinary microscope. The effect occurs only when high serum levels are attained, especially over 1,500 mg% of cholesterol; and the height of the layer increases roughly in proportion as the cholesterol level is raised by continued feeding. There is a marked difference in the cholesterol content of the two layers. In one serum the top layer contained 4,540 mg% of total cholesterol and 1,100 mg% of free cholesterol, whereas the bottom layer had 2,020 mg% total and 616 mg% of free cholesterol.

This very easily elicited difference in lipoid aggregates probably plays an important role in the experimental production of atheroma in the rabbit. The study of these layers should aid in determining the exact nature of the lipo-protein-cholesterol complexes.

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A Correction to North American Fauna No. 35

IT WAS recently suggested to the writer by Elliott S. Barker, State Game Warden of New Mexico, that the figures given by the late Vernon Bailey in "Life Zones and Crop Zones of New Mexico" (*North American Fauna No. 35* [1913]) for some of the life zones of New Mexico seemed to him to be seriously in error. Since Bailey's paper and its accompanying map are still in rather wide use, at least by students of faunistics, and since the areas of the life zones are of importance in certain phases of game management, we decided to check Bailey's map carefully to recompute the areas. We assumed the map to be reasonably accurate. It is, apparently, the only detailed map of the life zones of New Mexico in existence.

E. S. Barker, Richard Allgood, and Levon Lee together carefully checked a copy of this map, using a planimeter for all zones except the combined Hudsonian–Arctic–Alpine, which they estimated. The writer made an independent estimate from another copy of the map, by taking each township separately and estimating visually to the nearest 25% the proportion of the township in each of the several life zones. (There are approximately 3,400 townships in New Mexico, the area of the state being about 122,400

TABLE 1

Zone	Bailey (round figures, sq mi)	Barker (round figures, sq mi)	Campbell (actual figures, sq mi)
Lower Sonoran	18,000	19,400	19,516
Upper Sonoran	92,000	79,000	78,482
Transition	10,000	20,000	19,242
Canadian	2,000	3,850	4,167
Hudsonian	300	150	234
Arctic-Alpine	100		
Totals	122,400	122,400	121,641

sq mi.) The total number of townships in each life zone was thus found, and these figures were then multiplied by 36 to convert to square miles. It is not known how Bailey computed his estimate, but it is natural to suppose that he drew the map first and then used it as a basis.

Table 1 shows the three sets of available figures for the areas of life zones of New Mexico.

Evidently Bailey was wide of the mark in several cases, and the actual values of the zone areas in square miles may be taken to lie somewhere near the following figures: Lower Sonoran, 19,500; Upper Sonoran, 79,000; Transition, 19,700; Canadian, 4,000; Hudsonian–Arctic–Alpine combined, 200. The latter two zones are not separated on Bailey's map. Probably the Arctic–Alpine in New Mexico does not include more than 75 square miles. This would leave about 125 square miles for the Hudsonian.

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Glycols and Atomized *E. coli*

THE recent article by Nagy and Mouromseff concerning the effect of propylene and triethylene glycols on atomized *E. coli* (*Science*, **112**, 593 [1950]) deserves careful comment, since their conclusions are at great variance with those found by many other investigators. They interpret the results of their experiments as showing that glycol vapors are not germicidal but simply accelerate the settling out of airborne bacteria, thereby diminishing the bacterial population of the atmosphere. It is apparent from their data that they were dealing with bacterial aerosols containing many large particles, since only a bacterial cloud of predominantly large particle size would give such high initial settling plate and electrostatic precipitator recoveries. The use of unusually high atomizing pressures (50 psi) with a relatively coarse atomizer upon a culture containing an organism that is relatively fragile would tend further to eliminate the presence of viable bacilli in the finer particle size fractions of the dispersed aerosol. It has long been recognized that glycol vapors are relatively ineffective against large particles, especially if they are still in the liquid state in an atmosphere of high humidity. The use of more efficient sampling techniques than those dependent primarily upon the process of sedimentation would have greatly increased the significance of the experimental results they present.

Another very unfortunate feature is the lack of any quantitative information concerning the actual amount of either propylene or triethylene glycols present in the air of the treated environment at the time of atomization of the bacterial culture. In reporting the experiments performed in the 16-cu-ft chamber, no statement is made concerning the method of glycol vaporization. Since the concentration of glycol vapor is a critical factor in determining its efficacy as an aerial germicide, the omission of these data vitiates any conclusions that have been drawn. Furthermore, the operation of a commercial vaporizer (capacity unstated) for only 1 hr in the schoolroom (the dimensions of which are not given) prior to the atomization of the bacterial culture would make it unlikely that adequate germicidal concentrations were attained during the experiments cited. Equally deficient in essential information are the duct and room tests, in which no concentrations of glycol vapor are reported.

In summary, the data cited by Nagy and Mouromseff lack significance because of (1) the absence of definition and precision relative to the particle-size characteristics of the bacterial aerosol studied, (2) the use of sampling techniques appropriate only to the evaluation of large particles, which are relatively inefficient in determining the presence of viable organisms dispersed in the air as particles of less than 3 μ in diameter, and (3) the complete absence of any determinations of the glycol vapor content of the air.

In addition to lack of appreciation of the requirements for adequate experimental studies on aerial disinfection, numerous incorrect quotations from earlier work and apparent unawareness of the crucial experiments demonstrating the lethal action of propylene and triethylene glycols on various species of airborne bacteria make it evident that these authors did not acquaint themselves with the literature on this subject. That the effect of glycol vapors is not due, as Nagy and Mouromseff conclude it is, to a marked increase in the settling rate of bacteria-containing droplets, was clearly shown many years ago in this laboratory (Chicago) and has been corroborated since by others.

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WILLIAM LESTER, JR.

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THEODORE T. PUCK

Department of Biophysics
University of Colorado

WE appreciate the opportunity to answer the criticisms of Robertson, Lester, and Puck regarding our paper on the effect of glycols on atomized *E. coli*. The numerous papers on this subject, most of them by the investigators at the University of Chicago, deterred us for some time from publishing our results. Our tests, therefore, were devised to determine where the previous investigators may have erred. A more careful reading of our paper by them would have answered all their criticisms.

Our early tests on the use of glycols, which were not published, date back to 1941, and they all showed that vaporized or atomized glycols only increased the rate of settling of organisms and were not germicidal. The tests were interrupted by the war. Our interest was renewed when there was placed on the market a "vaporizer designed and manufactured by the research group who were instrumental in the original discovery" (quoted from instruction sheet supplied with vaporizer). This vaporizer was used for most of the tests in the 64-cu-ft box, schoolroom, and air ducts.

The air in the 64-cu-ft box was saturated with glycol as stated in the paper (Table 1, test 4). In the schoolroom there was a visible fog, as well as evidence of condensation of the glycol on the windows and desks. It will be noticed that the relative humidity was in the optimum range. Having access to all the literature on the subject, we were fully aware that the glycols were most effective at or near saturation. We were also aware, however, that both Puck (*1*) and Robertson *et al.* (*2*) stated that lesser amounts than saturation were germicidal. Finally, our tests show that sufficient glycol was present to greatly increase the rate of precipitation of the organisms. In no instance did we observe any germicidal effect.

The question of the particle size and rate of settling was also anticipated in making our tests. It will be seen from the paper that we used two types of sprayers. With both types, as shown in Tables 1 and 2, the organisms were settled over a period of time. Thus, in the 64-cu-ft box, which was 4 ft high, there were still some organisms in the air, and they were viable 20 min after spraying. Simple calculation using Stokes' law will show that these droplets were 3 μ or less in diameter. Likewise, the particle size of the bacterial clouds in the schoolroom was very small. Assuming the organisms fell a distance of 6–7 ft onto tables containing Petri plates in a period of 45–60 min (Table 2), the diameter of the particle, according to Stokes' law, was less than 3 μ.

In our tests a sampling technique was used that would collect most of the organisms. If we are to assume that Puck's theory and calculations (*3*) are correct, and that a bacterial particle increases in size and weight upon absorbing glycol, then we must use Petri plates or some other means to catch the rapidly precipitating particles. Our tests corroborate Puck's theory that rapid absorption of glycol does occur, as evidenced by the rapid precipitation of the bacterial clouds. However, in the Robertson *et al.* (*4, 5*) crucial experiment wherein they used a 60-l glass-walled chamber, all the organisms in the presence of glycol vapors would have been precipitated in 2.5 min and the air would have been sterile, just as they reported. Their Hollaender-Dallavalle sampler on the outside of the chamber could not have determined the precipitated organisms on the inside of the chamber. Thus, to overcome the obvious error in the above authors' apparatus, we used a 64-cu-ft chamber so that we could place the Petri plates in the chamber and increase the time of settling. Also, some of our tests were made with the electrostatic precipitator to collect the small, as well as the large, particles. The results were the same as on the Petri plates.

In conclusion, we have cited only the literature pertinent to the immediate problem. We have again rechecked our references before writing this letter and find no incorrect quotations. To those versed in the field of aerobiology, sampling of air for microorganisms has been a very difficult problem. It is not surprising, therefore, that the original investigators may have mistaken the rapid precipitation of bacteria for a germicidal effect.

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References

1. PUCK, T. T. *J. Exptl. Med.*, **85**, 741 (1947).
2. ROBERTSON, O. H., *et al. Ibid.*, **75**, 593 (1942).
3. PUCK, T. T. *Ibid.*, **85**, 729 (1947).
4. ROBERTSON, O. H., *et al. Science*, **93**, 213 (1941).
5. ROBERTSON, O. H. *Wisconsin Med. J.*, **46**, 311 (1947).

Book Reviews

Microbiology: General and Applied. William Bowen Sarles *et al.* New York: Harper, 1951. 493 pp. $4.50.

Our increasing awareness of the importance of microorganisms in the fields of industry, food, agriculture, medicine, and public health has created a growing desire for more adequate general information. As a result, many schools now offer a survey course in microbiology. The students entering such a class have widely differing backgrounds and interests and, in most cases, this will be their only formal contact with the subject. An interesting, up-to-date textbook that presents the various aspects of microbiology simply, briefly, and clearly is needed to supplement the class discussions and laboratory experiments. The authors of *Microbiology: General and Applied* have most ably satisfied this need.

Microbiology introduces the reader to the microorganisms: algae, molds, yeasts, bacteria, viruses, higher bacteria, and protozoa. In discussions on the physiology of living cells, the many functions and reactions to environmental influences are explained simply and understandably with a minimum of the chemical formulas that bewilder students with little or no chemistry. There are well-illustrated descriptions of the equipment required for experimentation in the laboratory and the techniques employed in the use of the microscope, the isolation of pure cultures, and the study of growth characteristics. The industrial importance of the various microorganisms producing commercial solvents, fermented beverages, antibiotics, dairy products, and so forth is thoroughly presented; and the essential role of bacteria in soil fertility is lucidly explained. The objectives and methods for the

purification of water and the treatment and disposal of sewage appear with discussions on the microorganisms of air, water, and sewage. There is an excellent section on the microbiology of foods, methods of preservation, milk and milk products, quality, and control of contamination. The book contains very adequate chapters on the nature and transmission of the infectious diseases of animals and plants, immunity, and the defenses of the host against disease. A final, brief presentation of the origin and development of microbiology is followed by three appendixes containing classification outlines of microorganisms in general, bacteria (according to Bergey), and yeasts and yeastlike fungi.

The interesting, readable style of *Microbiology* should appeal to all who desire accurate, nontechnical information about microorganisms and their activities. The book is so logically organized and well integrated that there is a feeling of continuity throughout. Key words are printed in bold-faced type that provides a real aid to one learning or reviewing the material. Also, new words are followed by a very brief definition in parentheses (often only one word) that introduces new terminology without interrupting the reader's train of thought. References are made to other books and reviews on specialized subjects rather than to the original articles that few beginners are capable of comprehending.

There has been a real need for just such a book. The authors are to be commended for furnishing microbiologists with this excellent survey of the field.

RUTH LOFGREN

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Protein and Amino Acid Requirements of Mammals. Anthony A. Albanese, Ed. New York: Academic Press, 1950. 155 pp. $4.00.

Numerous attacks on the problem of elucidating protein and amino acid requirements have been in progress during the past few decades. The present volume summarizes the approaches that have been fruitful and reports the present status of the problem. As with all collaborative publications, it has inherent in it both the strength and weakness of the approach by different authors from different viewpoints to the same broad problem. Careful editing has minimized duplication, however, although it has preserved the disparities that focus attention on the unresolved problems.

Awareness of the role of amino acids in protein composition led to the recognition that protein evaluation, in the nutritional sense, is a greatly diversified problem. As the concept developed, this problem came to be regarded as one involving a limited number of variables—the "essential" amino acids. More recently, amino acid interrelationships as well as vitamin-amino acid interdependence and appreciation of the importance of the "nonessential" amino acids have increased the number of variables with which modern investigation must cope. Moreover, nonchemical factors have pressed for attention to the point where considerations of species, function, and nutritional level strive with factors such as treatment of proteins before ingestion and route of ingestion in an over-all determination of requirements.

All these considerations are presented here in an admirably written series of reports from six individuals who have been among the leaders in the current attacks on this most complex and intriguing problem. Revisions in thinking elicited by their investigations are summarized by Mitchell in "Some Species and Age Differences in Amino Acid Requirements"; by Frost in "Method of Measuring the Nutritive Value of Protein Hydrolysates and Amino Acid Mixtures: The Rat Repletion Method"; by Silber and Porter in "The Laboratory Evaluation of Amino Acid Mixtures and Protein Hydrolysates"; by Chow in "Dietary Proteins and Synthesis of Tissue Proteins"; and by Albanese in "The Protein and Amino Acid Requirements of Man."

This reviewer is struck by the fact that most of the contributors to this volume have participated in one or another of two major cooperative projects that have occupied the attention of workers in the field the past few years. The importance of such cooperative efforts is amply manifest in their contributions to advancing knowledge, as revealed in these monographs. To their sponsors, the U. S. Pharmacopeia, through its Amino Acids Advisory Committee, and the Bureau of Biological Research of Rutgers University, all interested in this field are much indebted.

The book is well printed and bound, and apparently free of typographic errors.

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Human Physiology. Bernardo A. Houssay *et al.*; trans. by Juan T. Lewis and Olive T. Lewis. New York–London: McGraw-Hill, 1951. 1,118 pp. $14.00.

Written by experts for medical students and physicians, this English edition (and revision) of the original 1945 Spanish edition, is a significant contribution to medical education and medical progress in the English-speaking countries. The senior author, Dr. Houssay, a Nobel prize laureate in medicine, has been internationally known for his significant biological investigations for many years. This textbook reveals him and his associates as first-class teachers, by accuracy in facts, clarity of style, excellence of illustrations, and scientific objectivity in judgments and conclusions. Medical students, both graduate and undergraduate, will be aided, guided, and challenged by the references on nearly every page, and at the end of each of the 89 chapters, to pertinent publications on the particular problem discussed.

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The Dispensatory of the United States, Vols. 1 and 2.[1] Arthur Osol and George E. Farrar. Philadelphia: Lippincott, 1950. 2,189 pp. $25.00.

By including Volume Two in this 1950 publication, the 24th edition of the *Dispensatory* has been brought up to date. This makes available to pharmacists and physicians significant new developments in medicine without a revision of the 1,928 pages of the 24th edition. Although this volume affords a commentary on all new listings of the *Pharmacopoeia,* the deleted material is retained in Volume One.

The 259 new titles that comprise Volume Two are fully described. Much pertinent information is given, such as trade names and trade-marks, names of manufacturers and distributors, a short history of the discovery of each drug, pharmacologic data, therapeutic uses, toxicology, dosage, and the usual chemical and physical data.

Among the 88 unofficial items described in Part 7 are such new drugs as cortisone, pregnenolone, ACTH, terramycin, and many new antihistaminics. In addition to the valuable information presented in the *Dispensatory,* its worth is greatly increased by the citations of original references in the text.

The Dispensatory of the United States has been a dependable reference for pharmacists since its first publication in 1833. Its value was greatly enhanced in the earlier years of its existence, for revisions appeared two or three times in a decade, whereas the *Pharmacopoeia* was revised but once during the same period—until 1940. This meant that each revision of the *Dispensatory* within a decade could carry much new information about drugs that was not available in the *Pharmacopoeia.* In the years when the *Pharmacopoeia* was revised each ten years, and when the changes were not great, it was not too troublesome for the authors of the *Dispensatory* to include *Pharmacopoeia* text material in an otherwise new edition of their book.

The commentary character of the *Dispensatory* has given it value as a reference through the years. It has grown so voluminous that to revise it each five years, as is now done with the *Pharmacopoeia* and *National Formulary,* would impose a great burden upon the authors. This is a plausible explanation for the appearance of the 1950 edition, which is in reality not a new revised edition but the 24th edition with an addendum. The addendum is valuable and is available as a separate book for those possessing the 24th edition. This makes it unnecessary for anyone to buy a second copy of the old edition to obtain the information in Volume Two of the 1950 edition.

The appearance of the new *Dispensatory* is confusing because (1) the binder's label is in a different color than that of the 24th edition. This gives the impression that it is a new edition, which in fact it is not. (2) The edition number is omitted on the outside cover. (3) The use of the terms "Volume One" and "Volume Two" is new. Will the 25th edition, if and when it appears, be "Volume Three"? (4) Since Volume Two of the current edition is in the nature of an addendum, we believe it might well have been given that name.

This reviewer believes that the *Dispensatory* is a useful book for pharmacists but feels that the appearance of the next edition will lead to confusion and criticism unless the authors and publishers make its nature and purpose very clear. The price for Volume One sold separately is $20.00, for Volume Two $5.00, for the combined edition $25.00.

C. O. Lee

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[1] Volume One is comprised of Parts 1 to 5—1,928 pages including an index of 107 pages—and is based on *The Pharmacopoeia of the United States XIII* (1947), *The National Formulary VIII* (1946), *The British Pharmacopoeia* of 1932 and its addenda. Volume Two consists of Parts 6 and 7—259 pages including an index of 4 pages. Part 6 is a commentary on the 171 new titles of the *U.S.P. XIV*, *The National Formulary IX*, and *The British Pharmacopoeia* of 1948. Part 7 is a commentary on 88 nonofficial medicinals which are of recent development and new to the *Dispensatory*.

Association Affairs

Second Alaskan Science Conference

On September 4–8, the newly organized Alaska Division of the AAAS, in cooperation with the University of Alaska and with the assistance of the National Academy of Sciences, the National Research Council, and the Arctic Institute of North America, will hold a second Alaskan Science Conference at Mount McKinley National Park. The purpose of the conference is to survey the progress of science in Alaska and to examine the prospects for better application and development of science in Alaskan research. The conference will assemble, for the first time in Alaska, scientists actively engaged in research in the Territory in a program designed to promote closer collaboration and clearer understanding among all Alaskan scientists.

This conference has developed from a recommendation set forth by the First Alaskan Science Conference, conducted in Washington, D. C., under the sponsorship of the National Academy of Sciences–National Research Council.

Alaskan scientists welcome this opportunity to present in their first joint meeting the results of their research. They anticipate many advantages for ex-

tending the usefulness of their work through the forums for discussion that the conference will provide. Through association with their colleagues attending the conference from outside the Territory they look for improved relations with the great body of science which is the world's principal source of information for the guidance of humanity.

To their scientific guests, Alaskan scientists wish to extend, through the medium of the conference, the use of their facilities, and to offer their assistance in utilizing certain unique opportunities which this country affords for the advancement of science.

Further information concerning the conference may be obtained from the following sources:

Alaska: Rachel Spinney Simmet (Mrs. Robert P.), Executive Secretary
P. O. Box 960
Anchorage, Alaska

Washington: A. L. Washburn, Director
Arctic Institute of North America
1530 P Street, N.W.
Washington 5, D. C.

Please use air mail to avoid delay.

A steering committee under the chairmanship of Laurence Irving has arranged the following tentative program:

Tuesday, Sept 4—Opening Session
Evening: Address by the Chairman of the Conference, Governor Ernest Gruening
Installation of the Alaska Division in the AAAS by officials of the national association

Wednesday, Sept. 5—Survey of the Progress and Prospects of Scientific Research in Alaska
9: 00–11: 00 Biological Sciences
2: 00–4: 00 Physical Sciences
8: 00–10: 00 Social Sciences

Thursday, Sept. 6—Section Meetings

Friday, Sept. 7—Scientific Field Trips for Study of the Natural Features of the Mount McKinley Area

Saturday, Sept. 8—Business Meeting
A.M. Adoption of Constitution and By-Laws for the Alaska Division, AAAS
Election of officers for the division

Branches

At a winter meeting of the Springfield (Mass.) Branch the attention of the membership was focused on the specialized services scientists can contribute to civilian defense. R. I. Dunlap is already organizing a radiological monitoring section in the health division of Springfield's Civilian Defense organization, and specialists are being sought as volunteers for chemical analysis, special weapons of defense, bomb reconnaissance, and instruction. The meeting featured a talk by Frank D. Korkosz, of Springfield's Museum of Natural History. He discussed "The Role of the Planetarium in Modern Warfare." On May 8 the Branch participated in a joint meeting with Arcus Biologiae, the biology club of American International College. Thurlow C. Nelson, of Rutgers University, discussed "A Half-Century of Oyster Research."

New officers for the Lancaster (Pa.) Branch, elected for 1951–52, are: R. M. Foose, chairman; H. A. Robinson, vice chairman; W. G. Frankenburg, secretary; and M. A. Lewis, treasurer.

In May the AAAS Council authorized the establishment of an Alaska Division of the Association, with branches in the Anchorage and Fairbanks districts. Organization of the two branches is now complete, and for the Cook Inlet Branch the following officers have been elected: Laurence Irving, president; Don L. Irwin, vice president; Rachel E. Spinney, secretary-treasurer. Members of the executive committee are, for physical science, Charles W. Wilson, Marvin L. Slaughter; for biological science, Laurence Irving, Robert Scott; and for social science, Hugh Johnson and Lois Morey.

The Arctic Branch, centering at Fairbanks and the University of Alaska, named Andres I. Karstens, president; David Stowell, vice president; and John L. Buckley, secretary-treasurer.

The scientists of Juneau and its environs are now actively engaged in organizing a Southeastern Alaska Branch.

Academies

AAAS research grants have been given by the Florida Academy of Sciences to Edward P. St. John for work on Ophioglossaceae of the Southeast; by the Georgia Academy to H. W. Straley, III, of Georgia Institute of Technology, for studies of the subsurface structures of the coastal plain in northern Georgia; by the Indiana Academy to Winona Welch, of De Pauw University, for collecting bryophytes of Indiana, and to Duane Roller, of Wabash College, for a study of the early history of electricity from 1600 to 1775; by the Nebraska Academy to Otis Wade, of the University of Nebraska, for research on the summer activities of certain small hibernating animals; by the New Orleans Academy to Elinor H. Behre, of Louisiana State University, for studies of the effect of climate on the sexual season and sexual maturity of invertebrates, particularly crustacea; and by the Oklahoma Academy to Vincent E. Kurtz, of the University of Oklahoma.

Colorado-Wyoming Academy of Science has given AAAS research grants to Oliver V. Holtzmann, of Colorado A & M, for a study of the nature of pathogenicity in bacterial wilt of carnations, and to Charles F. Stowe, of the University of Denver, for work on the effect of methionine on growth and polycythemia in rats. Other AAAS research grants have been made by the Ohio Academy to Elizabeth W. Smith, of Kent State University, for her investigations in endocrinology, and to the Committee on Ohio Flora, to assist in a study of herbaria in Ohio, leading to the preparation of "Ohio Flora;" by the South Carolina Academy to Ruth Jones, of Winthrop College, and to A. M. Chreitzberg, Jr., of Wofford College; and by the West Virginia Academy to A. W. Scholl, of Marshall College, for research on the preparation of alkyl esters.

News and Notes

Symposium on the "Origin and Distribution of Cultivated Plants in South Asia"

G. S. Murty

The Indian Society of Genetics & Plant Breeding
New Delhi, India

A SYMPOSIUM on the origin and distribution of cultivated plants of South Asia was held in Delhi January 12–15. It was organized by the Indian Society of Genetics and Plant Breeding, with the cooperation and assistance of the Unesco South Asia Science Cooperation Office. In order to review the work done on a number of cultivated crops and to create a stimulus for further work on fundamental aspects of taxonomy, cytogenetics, and plant breeding, S. C. Harland (Manchester University), cotton geneticist; Edgar Anderson (Missouri Botanic Garden and Washington University), who has made a fundamental contribution on the origin of maize; and A. Muntzing, of Lund, Sweden, an authority on speciation of wheat and rye, came to Delhi especially for the symposium. The following workers on different crops from other Asian countries attended: M. F. Chandraratna (Ceylon); Mohammed Afzal and M. A. A. Ansari (Pakistan); R. E. Holttum (Singapore). From China Woon-Young Chun, Cheng Yin Wu, Hsioh Yu Hou, and Jen Hsu came as delegates from the Academia Sinica, Peking. Besides 14 Indian participants, there were observers from different scientific bodies and institutes, totaling about 50.

K. Ramiah, director, Central Rice Research Institute, Cuttack, and a past president of the Indian Society of Genetics and Plant Breeding, was elected chairman of the symposium. Each day, the session began with an introductory talk by one of the expert consultants. S. C. Harland spoke the first day on the various aspects of the centers of origin of crop plants, where plants with great genetical diversity may be found, and from which species move in time and space and gradually adapt themselves to changed environmental conditions. Adaptation to new conditions is often correlated with the phenomena of gene mutation and polyploidy. Edgar Anderson, who spoke on the second day, pointed out the importance of research on basic problems in the evolution of varieties of plants. He stressed the importance of the study of varieties and strains of cultivated plants from taxonomic, ethnobotanical, cytological, and genetical aspects. A. Muntzing in his talk on the third day emphasized the importance of determining centers of origin of cultivated plants. He further gave an account of the different plant-breeding institutes and botanical laboratories in Sweden and their organization and coordination with respect to various projects, especially in the breeding of plants for different climatic zones in Sweden.

In the discussions that followed, it was generally agreed that Orissa, Bengal, Assam, Burma, and outlying areas surrounding these states may jointly or individually be considered as the center of origin of rice, sugar cane, and brinjal. It is possible that cultivated rice (*Oryza sativa* L.) is of polyphyletic origin and was evolved from two or three of the wild rices. It was considered that some of the tetraploid species, such as *O. minuta* Presl of the Philippines, *O. eichingeri* Peter of Africa, *O. latifolia* Desv. of South America, and *O. coarctata* Roxb. of the delta region of the Ganges and the Irrawadi, have been evolved as a result of geographical isolation and change in environmental conditions.

On the subject of wheat the discussion centered around the extensive and complex hybridization work involving interspecific and intergeneric crosses, with a view to producing types resistant to different kinds of rusts in the wheat-breeding tracts of northern India.

The Indo-Burma-Malayasia region was recognized as an important center of origin for mango, banana, orange, and lemon. This area may be considered as the area of "maximum genetical variation." Mango, which is of hybrid origin from some unknown wild species, is a polyploid plant. The innumerable varieties of the common mango (*Mangifera indica* L.) have become differentiated from the original type or types, primarily through gene mutation. The edibility of the fruits of cultivated bananas is the result of the occurrence of parthenocarpy, which prevents formation of seeds. It is believed that both parthenocarpy and female sterility arose as a result of gene mutations in the fertile diploids *Musa acuminata* Colla, and *M. balbisiana* Colla. The edible varieties of banana, which are triploids, are often characterized by variable chromosome morphology within the same individual. The numerous cultivated races of banana of both hemispheres appear to have originated as bud mutations during centuries of vegetative propagation from a few primary triploid seedlings.

The North Indian sugar canes appear to have arisen by extensive natural hybridization between two species—*Saccharum officinarum* L. and *S. spontaneum* L. By means of careful cytogenetical methods, the sugar cane, which is a very high polyploid species, can be traced back to two different ancestral primary species with the basic chromosome members of *n*-5 each. One of these is present in a related genus, *Sclerostachya*, in India. The slopes of the Himalayas contain a large number of interesting types that are likely to be of great value in evolving special types suitable for the different regions of India.

A number of small-grained cereals are grown in the poorer soil of Central and South India. Of these, *Sorghum vulgare*, *Pennisetum typhoides*, and *Setaria italica* are important. Hybridization and cytological studies of these millets are being carried on at Coimbatore, and the progress of this work was reported in

the symposium. Most of the wild relatives of the jute plants (*Corchorus olitorius* and *C. capsularis*) are found in dry areas of Africa, Egypt, Arabia, and West Pakistan, but the commercially important jute plants have been adapted to moist climate and areas with moderate to heavy rainfall. It was agreed that, although *C. olitorius* originated in Africa, where numerous allied forms of this species are found, *C. capsularis* appears to have originated in the Indo-Burma region or in Malayasia.

In Pakistan the introduction of American types of cotton has been going on since 1914, and at present 90% of the cotton crop there is grown from "American" seeds. The Indian cotton (*Gossypium arboreum*) was considered to have been derived from the African species *G. anomalum*.

Besides the review of genetics of plants, the symposium brought out some interesting points that would be of value for any long-range program for the improvement of crop plants. Some of the suggestions are as follows:

a) Plant introduction should be made from areas having similar or nearly similar climatic or environmental conditions. It would therefore be preferable to introduce plants from Mexico, Peru, and Guatemala in the regions of South Asia where climatic conditions are suitable. An organization should early be developed for plant introduction on these lines.

b) Appropriate national or international organizations should be set up to explore various regions of South Asia for economic and related wild plants.

c) For advancement in fundamental and practical knowledge in the breeding of better plants, cytogenetical work, as well as development physiology of all cultivated and related plants, should be developed in the botanical research centers.

d) Advancement in the taxonomy of cultivated plants is another necessity, and for this purpose "inclusive herbaria" of all races and varieties of cultivated crops should be made and located in the various plant-breeding centers.

Scientists in the News

The second Augustus B. Wadsworth Lecture was given in Albany by **Francis G. Blake,** Sterling professor of medicine, Yale University, on "The Present Status of Antibiotic Therapy with Particular Reference to Chloramphenicol, Aureomycin, and Terramycin." The lectureship was established in 1950 by the staff of the Division of Laboratories and Research of the New York State Department of Health and the Council of the New York State Association of Public Health Laboratories. Dr. Wadsworth retired as director of the Division of Laboratories and Research in 1945 after 31 years of continuous service.

Chauncey G. Bly, of the University of Rochester School of Medicine, will join the University of Kansas Medical Center as assistant professor of pathology and oncology on July 1. The American Cancer Society recently announced his selection as one of five Scholars in Cancer Research. **Harold Garner,** Purdue; **E. Forber,** Tulane; **H. J. Koch,** Memorial Center for Cancer and Allied Diseases; and **J. F. Scott,** Massachusetts General Hospital were also given scholarships, each of which carries an award of $18,000 over three years to the university in support of the scholar's research.

E. A. R. Braude, Imperial College, London, has been awarded the Meldola Medal for 1950. This medal is presented annually to the British chemist under 30 years of age who shows the most promise as indicated by his published works.

M. M. Brooke, chief of the Communicable Disease Center Parasitology and Mycology Section, is in Korea to serve on a special commission to study diarrhea and dysentery. The Armed Forces Epidemiological Board set up the Korean commission for a study that will require several months. Dr. Brooke, a senior scientist, or commander, in the PHS commissioned corps, has been on the staff of the Communicable Disease Center Laboratory Services since entering the Public Health Service in 1945. He also is associate professor of parasitology in the Emory University School of Medicine.

Alden Cutshall, in charge of geography, Chicago Undergraduate Division, University of Illinois, has been in the Philippines since last July on a Fulbright research award. Before he returns to Illinois for the fall semester, he will assist the East Asia Science Cooperation Office of Unesco (Manila) with the preliminary organization of a science workshop.

The Trudeau Medal of the National Tuberculosis Association was awarded to **Rene J. Dubos,** a member of the Department of Pathology and Bacteriology of the Rockefeller Institute for Medical Research, at the annual meeting of the association. Named in honor of the late Edward Livingston Trudeau, first president of the association, the medal was established in 1926 and has been awarded annually since for "the most meritorious contributions on the cause, prevention or treatment of tuberculosis." In the citation, particular attention was called to the work of Dr. Dubos in devising a method for the culture of the tubercle bacilli that speeds their growth.

E. H. Dusham, head of the Department of Zoology and Entomology of Pennsylvania State College School of Agriculture, will retire at the end of the summer session.

At the annual session of the American College of Physicians **Rolla E. Dyer,** director of research, Emory University, was awarded the James D. Bruce Memorial Medal for 1951 in the field of preventive medicine. **E. E. Irons,** of Chicago, former president of the college and of the AMA, was awarded a mastership at the convocation. **George M. Piersol,** of Philadelphia, who has been secretary-general of the college for 25 years, was awarded the Stengel Memorial Diploma. **Maurice C. Pincoffs,** professor of medicine at the University of Maryland, was inducted as the president for 1951–52.

Alvin C. Eurich, president of the State University

of New York, is resigning to accept the vice presidency of the Ford Fund for the Advancement of Education. The University was created by the legislature in 1948 to operate existing state higher educational institutions and to create new facilities. Dr. Eurich took office as its first president on January 1, 1949. Prior to that he had been acting president of Stanford University. He will take over all operations of the Ford Fund in the East, with headquarters at 575 Madison Ave. The principal offices are in Pasadena, Calif. No date was announced for Dr. Eurich's actual resignation from the State University. It was understood he would continue in that post and serve part time for the Ford Fund until his successor is chosen, but not longer than September 1.

At a symposium on "Human Factors in Equipment Design," held at Birmingham University, Birmingham, Eng., three representatives from the U. S. presented papers: **Paul Fitts**, for the Psychophysiology Branch of the Office of Naval Research; **Arnold Small**, head of the Human Factors Division, for the Bureau of Ships, and **Lloyd Searle** for the Naval Research Laboratory.

Lester R. Ford, chairman of the mathematics department of Illinois Institute of Technology, was honored recently at a special meeting of the Men's Mathematics Club of Chicago. Dr. Ford is past president of the Mathematical Association of America and was editor of the *American Mathematical Monthly*. He has taught almost 40 years, the last 14 at Illinois Tech.

Among British scientists visiting the U. S., **F. C. Frank**, of Bristol University, is spending four months in the G-E Laboratories at Schenectady, where he will continue his research on solid-state physics with particular reference to dislocation theory. **N. P. Allen**, superintendent of metallurgy at the National Physical Laboratory, Teddington, has just toured American laboratories and universities. His trip was sponsored by the Bureau of Standards. **J. O'M. Bockris**, of the Imperial College of Science and Technology, delivered the Richards Memorial Lecture of the Electrochemical Society. His program included other lectures, and visits at Carnegie Institute of Technology, MIT, and Brooklyn Polytechnic.

Julian Glasser, physical chemist at Armour Research Foundation, has been named technical aide on titanium and zirconium research in a new metallurgical unit of the National Research Council. Dr. Glasser is on leave for six months to work with the metallurgical projects division of the new metallurgical projects board headed by **W. E. Mahin**, director of research at the Foundation. The metallurgical board advises the Research and Development Board, Department of Defense, on critical metals problems.

Jack C. Haldeman has been appointed chief of the Division of State Grants, Public Health Service, succeeding **Estella Ford Warner**. Since 1948, Dr. Haldeman has been medical director of the Arctic Health Research Center in Anchorage, Alaska, where he has been responsible for extensive studies of communicable and nutritional diseases and sanitation problems peculiar to low-temperature areas. He has also been active in organizing the new Cook Inlet Branch and the Alaska Division of the AAAS.

P. G. Harvey, of the Imperial Chemical Industries of England, is in the U. S. under the ECA educational program. He is one of 50 young engineers who are studying U. S. production methods and doing advanced research work at American universities. He plans to return to England in July.

Robert Thomas Legge, emeritus professor of hygiene and former university physician on the Berkeley campus of the University of California, has received the William S. Knudsen Award, highest honor in industrial health, from the American Association of Industrial Physicians and Surgeons. Dr. Legge assumed his duties at the university as professor and chairman of the Department of Hygiene, university physician, and director of the College Hospital on the Berkeley campus in 1915.

W. Randolph Lovelace 2nd, of Albuquerque, N. M., will succeed **Richard L. Meiling** July 1 as chairman of Armed Forces Medical Policy Council. Dr. Meiling, who has been on leave of absence from Ohio State since 1949, will return to the university as associate dean of the College of Medicine and associate medical director of the New University Hospital.

The Chicago Natural History Museum reports that **Bryan Patterson**, curator of fossil mammals, and **Orville L. Gilpin**, chief preparator of fossils, are collecting fossil microfauna in the early Cretaceous Trinity sands of north-central Texas. **Alexander Spoehr**, curator of oceanic ethnology, has been awarded a National Research Council grant to complete documentary research in connection with the museum's Micronesian Anthropological Expedition that he conducted in 1949–50. The State Department has given **George I. Quimby**, curator of exhibits in anthropology, a Fulbright grant to serve as visiting lecturer at the University of Oslo in 1952. The botanical field trip to Florida, conducted by **Emil Sella**, curator of exhibits, and **Samuel H. Grove, Jr.**, artist-preparator, has provided the museum with a large collection of flowering plants. **Hugh C. Cutler**, curator of economic botany, is conducting the institution's 1951 Southwest Botanical Expedition in New Mexico and Arizona. Dr. Cutler will make special studies of the vegetation growing about sites such as Tularosa Cave, which was excavated by the museum's 1950 Southwest Archaeological Expedition. The largest current expeditionary undertaking, the Archaeological Expedition to the Southwest, is resuming operations this month. The 1951 season's work, like that of last year, will consist of digging into ancient caves in Pine Lawn Valley, near Reserve, N. M. **Paul S. Martin**, chief curator of anthropology and leader of the expedition, has already opened the expedition camp.

Charalambos S. Stephanides, livestock specialist and

agricultural economist, is in Iran as a representative of the USDA, to work with the Iranian Government in its rural development program. He will give special assistance to the livestock improvement program of Iran's Ministry of Agriculture. The assignment was made cooperatively with the Technical Cooperation Administration of the Department of State, at the request of the government of Iran. Dr. Stephanides has been a staff member of OFAR since 1947. Previously, he served for eight years as local agricultural agent in Greece, where he worked among resettled refugees in Macedonia and Thrace, helping them to develop a livestock improvement program.

Harald Ulrik Sverdrup, geophysicist, has been named the thirteenth recipient of the William Bowie Medal by the American Geophysical Union (Committee on Geophysics of the National Research Council). Dr. Sverdrup, a native of Norway, is now the director of the Norwegian Polar Institute in Oslo. He is well known in the United States, chiefly through his twelve-year tenure (1936–48) as the director of the Scripps Institution of Oceanography of the University of California. The William Bowie Medal was first awarded in 1939 to the late William Bowie, in whose honor it was named.

C. E. Turner, WHO consultant in Health Education, has been in Egypt to work with the joint WHO-Unesco Fundamental Education Team operating in the Sindibus area, near Cairo. This team, in cooperation with the Egyptian Ministries of Education, Health, and Social Affairs, is concentrating on improving techniques in agriculture, health, and fundamental education, with special emphasis on literacy. His work in Egypt was preceded by a visit to Iraq.

William Vogt, former chief of the conservation section of the Pan American Union, has been named director of the Planned Parenthood Federation of America. He recently returned from Scandinavia on completion of a population study made under combined Guggenheim and Fulbright fellowships.

Nils Y. Wessell, dean, Tufts School of Liberal Arts, has been elected vice president of Tufts College, and **John P. Tilton,** dean of the Graduate School, has been elected to the newly created position of provost. Dr. Wessell became dean at Tufts College in 1938. He will continue his duties as dean and as director of admissions in the School of Liberal Arts. Dr. Tilton joined the Tufts faculty in 1927. In addition to serving as dean of the graduate school, he is director of the Division of Special Studies and director of the Tufts Summer School.

Ralph E. Wilson, staff member of the Mount Wilson and Palomar Observatories, has just retired. A scientific symposium in his honor will be held in Pasadena at the summer meeting of the Astronomical Society of the Pacific, of which he was president in 1946. Its subject will be "Radial Velocity Programs of Pacific Coast Observatories." Dr. Wilson has been associated with the Mount Wilson Observatory since 1938.

Colleges and Universities

Twelve liberal arts colleges have entered into an agreement with **Columbia's School of Engineering** to provide for a broader education in engineering, beginning with the 1951 academic year. Students completing three years of study at one of the cooperating colleges and a short summer course in field work at Camp Columbia, Lakeside, Conn., will be automatically admitted to Columbia for two years of work in engineering. At the end of the five years, they will be given appropriate Bachelor's degrees from both institutions. Colleges participating in the program are: **Allegheny, Baldwin-Wallace, Franklin and Marshall, Hobart and William Smith, Hofstra, Juniata, Marietta, Miami University, Middlebury, Queens,** and **St. Lawrence** and **Washington and Lee Universities.**

The **University of Illinois** has begun construction of a new Drug and Horticultural Experiment Station near Lisle, Ill., for joint use of the Colleges of Pharmacy and Agriculture. Research at the station eventually will involve plant chemistry, soil analysis, plant breeding, pathological studies of plants, and work on insecticides, rodenticides, and fungicides.

Harlan Henthorne Hatcher, vice president of Ohio State, has been elected eighth president of the **University of Michigan,** succeeding Alexander G. Ruthven, who will begin his retirement furlough July 1. Dr. Hatcher will take up his new post on September 1.

North Dakota Agricultural College will offer its fourth annual Paint Short Course for beginners, in its School of Chemical Technology, July 9–20. Lectures and laboratory work will deal with the various aspects of and recent developments in paints, varnishes, and other protective coatings. An advanced short course will be held August 6–17, for which two years' experience or training in the protective coatings industry is prerequisite. Wouter Bosch will be in charge of the courses.

Under the auspices of the **Research Participation Program,** a joint activity of the Oak Ridge Institute of Nuclear Studies and the Oak Ridge National Laboratory, 70 faculty members, largely from Southern universities, are working this summer in Oak Ridge National Laboratory, with the Institute Medical Division, and in the University of Tennessee–AEC Agricultural Research Program. Three one-month courses in radioisotope techniques offered by the Special Training Division will take 96 participants to Oak Ridge, 20 are enrolled in the course in autoradiography, and several hundred are expected for the symposium on "The Role of Engineering in Nuclear Energy Development," August 27–September 7.

The **University of Paris Medical School** is sponsor of an international contest among doctors and medical researchers working on a cure for splenomyelogenous leukemia. The prize will be 2 million francs, or approximately $5,700, part of which *may* be awarded for a piece of research leading to substantial progress in

the treatment of the disease. Candidates for the prize should send their papers to Léon Binét, dean of the school, 12 rue de l'Ecole de Médecine, Paris 6. Members of the committee that will evaluate the work are, in addition to Dr. Binét, Paul Chevallier, Maurice Lamy, André Lemaire, and Jean Bernard.

Ohio State University dedicated its new $1,100,000 Physics Building on June 11, which was also the opening date for the annual five-day symposium on "Molecular Structure and Spectroscopy." Among speakers at the dedication ceremonies were Clare O. Ewing, William V. Houston, Alpheus W. Smith, N. Paul Hudson, John H. Van Vleck, and Harald H. Nielson.

Oklahoma Medical Research Institute and Hospital, which are being developed by an independent, nonprofit foundation, academically affiliated with the University of Oklahoma School of Medicine, have appointed an eight-member National Advisory Board. Roy G. Hoskins is chairman, and the other members are Allan T. Kenyon, C. N. H. Long, Edward A. Doisy, J. Murray Steele, C. J. Van Slyke, Joseph C. Aub, and Stafford L. Warren.

As part of **Saint Louis University's Summer Institute for the Teaching of Chemistry,** June 20–July 27, the following scientists and educators will give a series of public lectures: Hubert N. Alyea, Sidney J. French, Elbert C. Weaver, and Robert J. Henle. The institute will also offer graduate lecture courses reviewing general chemistry, and seminars on kinetic theory of gases, the Bronsted acid-base theory, transmutation of elements, the structural theory of organic compounds, and problems of teaching chemistry.

The **University of San Carlos** in Guatemala City will hold its fifth annual six weeks' summer session for North Americans July 2–August 10. It will feature intensive study of Spanish, Spanish and Hispanic-American literature, history, and related subjects, and specialized courses on Mayan culture, art, and architecture. There will be weekend excursions to Antigua, Lake Atitlán, Chichicastenango, and some of the Mayan ruins. Further information may be obtained from The Secretary, San Carlos Summer School, Apartado 179, Guatemala, C. A.

Jess Harrison Davis, president of Clarkson College of Technology, has been elected president of **Stevens Institute of Technology,** the fourth president in its 81 years. He succeeds Harvey N. Davis, who is retiring after 23 years of service. The two Davises are not related.

University of Wisconsin regents have approved the appointments of Andrew H. Clark as professor of geography, and of Brynjolf J. Hovde as visiting professor of Scandinavian area studies. Professor Clark will go to the university from Rutgers, where he has been chairman of the Department of Geography since 1949. Professor Hovde is president of the New School for Social Research, New York.

Grants and Fellowships

The Atomic Energy Commission has awarded 13 new unclassified research contracts and renewed ten, bringing the total of new awards to 398. New contracts in physical research went to J. R. Lacher and J. D. Park, University of Colorado; W. A. Selke, Columbia; P. W. Gilles, University of Kansas; H. C. Brown, Purdue; H. W. Davis, University of South Carolina; R. A. Peck, Brown; and M. L. Pool, Ohio State; in biology and medicine to M. A. Fischer and S. E. Purvis, University of Pittsburgh; A. E. Taylor and C. W. McIntosh, Idaho State; Paul K. Smith, George Washington; Loyal Davis, Northwestern; J. H. Quisenberry, Texas A & M; and A. F. Scott, Reed College.

Associated Serum Producers, Inc., sponsors of the American Foundation for Animal Health, have allocated a long-term grant-in-aid to the Veterinary Research Institute of Iowa State College for research on problems related to hog cholera virus. A committee of veterinarians from the staffs of the 19 sustaining member companies will act in an advisory capacity to the staff of the institute in the development of the program.

The **T. J. Brown and C. A. Lupton Foundation** has given $18,000 to the University of Texas Medical Branch for support of a fellowship in the Division of Plastic Surgery. T. G. Blocker, Jr., will be in charge of studies of a comparison of the exposure method of handling severe burns with orthodox and pressure techniques.

The National Foundation for Infantile Paralysis has established a new type of short-term predoctoral fellowship for undergraduate medical students. Under the plan the dean of each four-year medical school nominates one medical student to receive a fellowship, which will cover a minimum of two months of summer laboratory study to enable the student to test his desires and aptitudes at an early stage in his professional career.

The Department of State has released a pamphlet entitled ***International Exchange Opportunities,*** which supersedes its publication on exchanges under the Fulbright Act. It is for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for ten cents, and contains information on the Fulbright program, the United States Information and Educational Exchange (Smith-Mundt) Act, the Buenos Aires Convention, specialized programs for Germany and Austria, educational exchanges with Finland, the Chinese Emergency Aid Program, and descriptions of other study and teaching opportunities for both U. S. citizens and foreign nationals.

RCA Institutes, Inc., has awarded scholarships for advanced radio technology courses to William Delaney, Richard A. Wallner, and Stuart A. Rosenkrants, all of the New York metropolitan area. The winners were chosen on the basis of competitive examinations.

In the Laboratories

Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon, has appointed Granville A. Perkins vice president in charge of research. Dr. Perkins, who has been with the company since 1929, is at present in charge of extensive research laboratories in South Charleston, W. Va.

The **Du Pont Company** has won the National Safety Council's Distinguished Service Safety Award for the ninth consecutive year. The number of time-losing injuries per million man-hours worked in 1950 was 0.72 for the combined operations, an improvement of about 5% over 1949, in which the company's record was 14 times better than that of industry as a whole. The Martinsville, Va., nylon yarn plant, employing more than 3,000 men and women, holds the world's record for man-hours worked without a lost-time injury.

The **Gulf Coast Research Laboratory,** under the sponsorship of the Mississippi Academy of Sciences, Inc., was opened in Ocean Springs on June 11. R. L. Caylor, Delta State Teachers College, and a staff of 17 instructors will present seven courses. Although the laboratory is controlled by the Board of Trustees of the Institutions of Higher Learning of the State of Mississippi, it will accept students from any part of the world. Ninety men and women students can be accommodated.

The **Institute of Inventive Research** has appointed James V. McGoodwin, a former executive with the Hughes Tool Company, as director. Mr. McGoodwin, who was associated with Paul G. Hoffman on the Committee for Economic Development, was named San Antonio's "Man of the Year" in 1949.

Landsverk Electrometer Company, in which Technical Associates, Glendale, Calif., purchased a substantial interest this year, will soon move into its new building at 3730 San Fernando Road, Glendale 4.

Meyer Scientific Supply Company, Inc., has recently moved to new and larger quarters at 211–215 N. Eighth St., Brooklyn 11.

The **National Institutes of Health,** Bethesda, Md., will hold an open house on June 22 from 1:00 to 9:00 P. M. President Truman will make the major address and lay the cornerstone for the Clinical Center, which will be one of the largest and best equipped research hospitals in the country.

New England Deaconess Hospital Cancer Research Institute and **Elliott P. Joslin Auditorium,** Boston, were dedicated June 5. Sidney Farber, Shields Warren, and Charles H. Best participated in the ceremonies and the afternoon scientific session. The new cancer center will also house the Laboratory of Pathology of the Harvard Cancer Commission, the Massachusetts State Tumor Diagnosis Service, and the Cancer Control Unit of the Harvard School of Public Health.

Meetings and Elections

At the annual meeting of the **American Physiological Society** R. W. Gerard, of the University of Chicago, was elected president for 1951–52. Other officers elected were: president-elect, E. M. Landis, Harvard Medical School; councilors, H. W. Davenport, University of Utah, and H. E. Essex, Mayo Foundation. Dr. Essex was chosen secretary-treasurer of the council for the coming year.

The 83rd annual meeting of the **Kansas Academy of Science** was held at the University of Kansas May 3–5. The following officers were elected: president, A. B. Leonard; president-elect, J. R. Wells; vice president, R. E. Mohler; secretary, A. M. Guhl; treasurer, Standlee Dalton; librarian, D. J. Ameel; delegate to the Academy Conference, A. M. Guhl. David Bodian, of Johns Hopkins University, was the guest speaker; he discussed "The Biology of Polio Virus."

The **National Academy of Sciences** has elected Alexander Wetmore home secretary for a four-year term beginning July 1, to succeed Fred E. Wright, who has held the office for twenty years. J. W. Beams and E. C. Stakman were elected to membership on the Council, to serve until June 30, 1954. The Academy elected 29 new members and three foreign associates (Pentti Eskola, Helsinki University; Sir Godfrey Thomson, Edinburgh University; and Karl von Frisch, University of Munich).

The following officers were elected by the **New Orleans Academy of Sciences** at the annual meeting held at Tulane University April 27: president, Mary Rollins, Southern Regional Research Laboratory; vice president, Walter G. Moore, Loyola; secretary, Karlem Riess, Tulane; treasurer, Carl M. Conrad, Southern Regional Research Laboratory; curator, Garland Taylor, Tulane; members of the executive council: Joseph Ewan, Tulane, and Philip C. Wakeley, Southern Forest Experimental Station.

The world's first **Space Medicine Society,** organized last month in Denver by doctors attending a meeting of the Aero Medical Association, chose Paul A. Campbell as chairman. Hubertus Strughold was named secretary.

A **Conference on Auroral Physics,** jointly sponsored by the Physics Department of the University of Western Ontario and the Geophysical Research Directorate of the Air Force Cambridge Research Laboratories, will be held July 23–26 at the University of Western Ontario, London. The entire field of auroral physics will be given consideration, with theoretical papers presented by internationally known scientists. General topics to be discussed will deal with the formation of the aurora, mechanisms of solar corpuscular streams, and excitation mechanisms in the ionosphere (80–400 km) and in the mesosphere (400–1,000 km). Several papers will be presented on the identification and interpretation of the emission spectra of the ionosphere and mesosphere and other observational studies.

Meetings & Conferences

June 18–23. Pacific Division, AAAS. University of Southern California, Los Angeles.

June 18–29. Institute on Human Relations and Intergroup Understanding. The American University, Washington, D. C.

June 19–21. American Meteorological Society (National). Los Angeles.

June 20–22. Heat Transfer and Fluid Mechanics Institute. Stanford University, Stanford, Calif.

June 20–23. American Astronomical Society (Annual). Washington, D. C.

June 21–27. Conference on Psychiatric Education. Cornell University, Ithaca, N. Y.

June 22–23. American Academy of Dental Medicine (Annual). Hotel Dennis, Atlantic City.

June 22–23. American Mathematical Society. Symposium on Applied Mathematics Fluid Dynamics. College Park and White Oak, Md.

June 22–23. Applied Mechanics Conference. Stanford University, Stanford, Calif.

June 25–26. Mathematical Association of America (joint with American Society for Engineering Education). Michigan State College, Lansing.

June 25–28. American Physical Society. Vancouver.

June 25–29. American Institute of Electrical Engineers. Royal York Hotel, Toronto.

June 28–30. American Society of Ichthyologists and Herpetologists. Chicago Natural History Museum, Chicago.

June 28–30. Institute of Navigation (Annual). New Yorker Hotel, New York.

June 28–30. National Science Teachers Association. Mills College, Oakland, Calif.

June 28–30. International Meeting on Spectroscopy. Basel.

July 2–4. International Conference of Naval Architects and Marine Engineers. Glasgow.

July 2–6. South African Association for the Advancement of Science (Annual). Durban.

July 3–6. Scientific and Clinical Convention of the Association for Physical and Mental Rehabilitation. Hotel Hollywood Roosevelt, Los Angeles.

July 4–6. International Conference of Naval Architects and Marine Engineers. Newcastle.

July 5–7. Physical Society (Summer). Belfast.

July 9–11. Conference on Science in General Education. Harvard University, Cambridge, Mass.

July 9–13. Conference on Control of the Anterior Pituitary. Ciba Foundation, London.

July 9–13. Society of Chemical Industry (Annual). London.

July 9–14. American Association of Colleges of Pharmacy. Purdue University School of Pharmacy, Lafayette, Ind.

July 9–14. Industrial Microbiology Institute. Purdue University, Lafayette, Ind.

July 11–14. Commission on Symbols, Units, and Nomenclature of the International Union of Pure and Applied Physics. Copenhagen.

July 14–21. International Welding Congress. Oxford and London.

July 16–20. International Congress of Clinical Pathology. London.

July 16–21. International Congress of Psychology. Stockholm.

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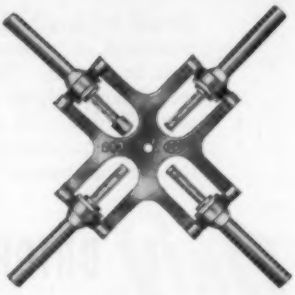
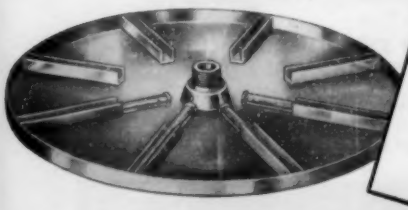


No. 213, 4-place head with 4 No. 301 metal shields



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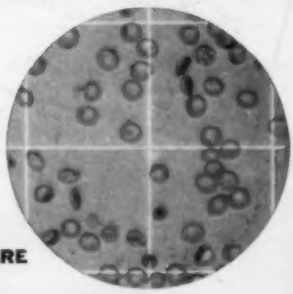

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